January 1994

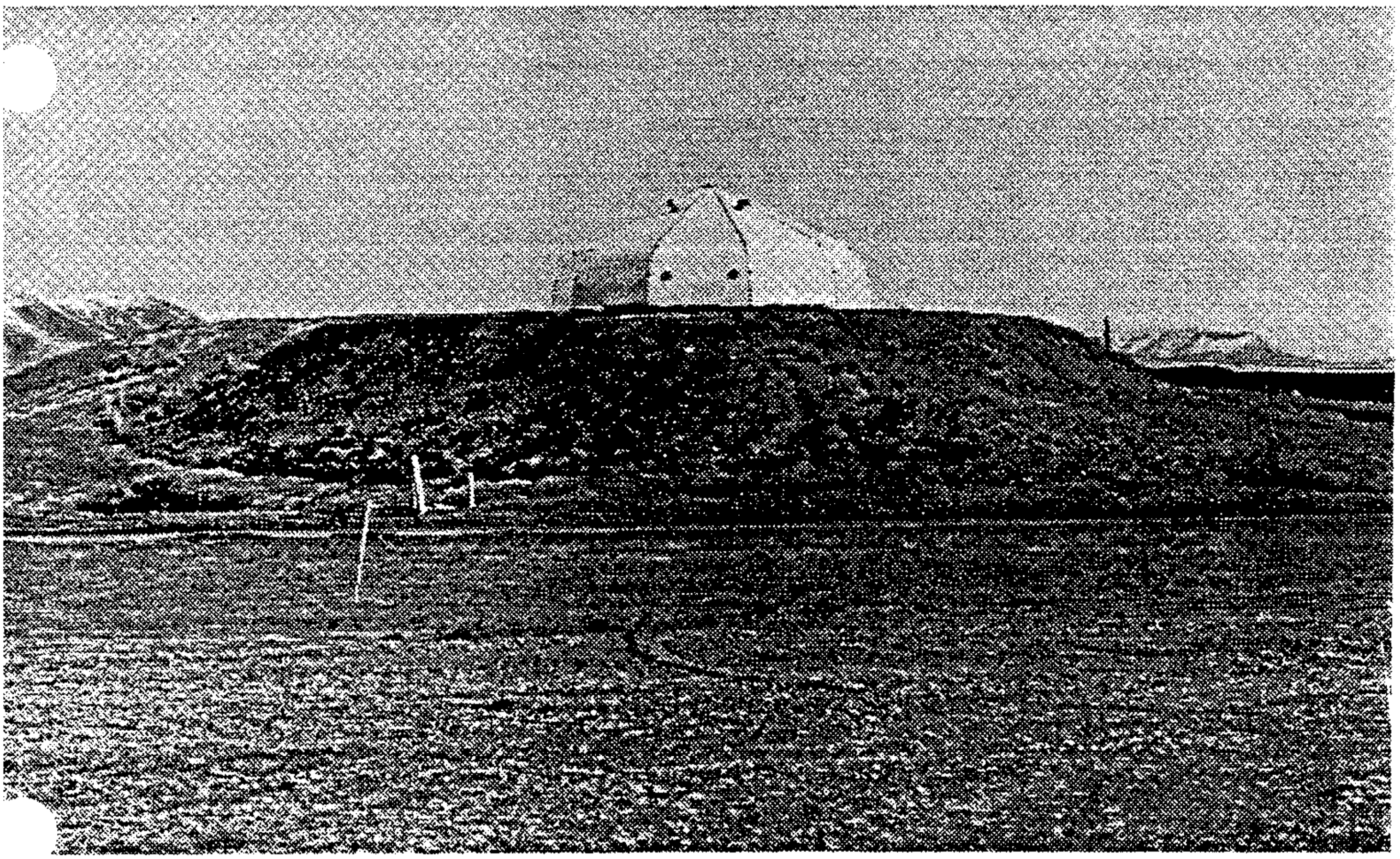
Idaho National Engineering Laboratory

IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY

Record of Decision

Declaration for Pad A at the Radioactive Waste Management Complex Subsurface Disposal Area

at the Idaho National Engineering Laboratory Idaho Falls, Idaho



DECLARATION FOR PAD A
AT THE RADIOACTIVE WASTE MANAGEMENT COMPLEX
SUBSURFACE DISPOSAL AREA
AT THE IDAHO NATIONAL ENGINEERING LABORATORY
Idaho Falls, Idaho

DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

Pad A
Radioactive Waste Management Complex
Subsurface Disposal Area
Idaho National Engineering Laboratory
Idaho Falls, Idaho

STATEMENT OF BASIS AND PURPOSE

This document presents the selected remedial action for Pad A, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and is consistent, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the Pad A Remedial Action.

The U.S. Environmental Protection Agency (EPA) approves of this remedy and the State of Idaho concurs with the selected remedial action.

ASSESSMENT OF THE SITE

Threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a potential threat to public health, welfare, or the environment. Implementation of the remedial action selected in this ROD will provide recontouring, maintenance, monitoring of the cover, and institutional controls at Pad A to ensure effectiveness of the existing cover and to minimize potential future exposure and migration of contaminants from the pad. If contaminants from Pad A were to migrate from the pad, they may potentially contaminate the subsurface area or groundwater.

DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses Pad A at the Radioactive Waste Management Complex (RWMC), Subsurface Disposal Area (SDA), at the Idaho National Engineering Laboratory (INEL). The RWMC has been designated as Waste Area Group (WAG) 7 of the 10 WAGs at the INEL that are under investigation pursuant to the Federal Facility Agreement and Consent Order (FFA/CO) between the Idaho Department of Health and Welfare (IDHW), the Environmental Protection Agency (EPA), and the U.S. Department of Energy Idaho Operations Office (DOE-ID). Pad A, designated Operable Unit (OU) 7-12, is located within WAG 7. The selected remedy for Pad A will provide for soil cover contouring and slope correction, routine maintenance, and monitoring. The function of this remedy would be to reduce the risks associated with potential exposure to and migration of the contaminated wastes.

The major components of the selected remedy include:

- Recontouring and slope correction of the existing Pad A soil cover, followed by maintenance, including subsidence and erosion control, to ensure effectiveness.

- Monitoring of groundwater, soil, surface water, and air to provide early detection of a potential release from Pad A to the subsurface, groundwater, or surface pathways.

- Maintaining institutional controls, including maintaining existing signs and postings, restricting access, and maintaining existing fences/barriers. It is presumed that institutional controls would remain in place indefinitely and this presumption will be reviewed every 5 years.

STATUTORY DETERMINATION

The selected remedy is protective of human health and the environment, complies with Federal and State applicable or relevant and appropriate requirements (ARARs), and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site; however, because the wastes can be reliably controlled in place, treatment of the principal sources of contamination was not found to be necessary. Therefore, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within two years after commencement of remedial action, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

Signature sheet for the foregoing Pad A located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

1-27-94

GERALD A. EMISON
Acting Regional Administrator, Region 10
U.S. Environmental Protection Agency

Date

Signature sheet for the foregoing Pad A located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

AUGUSTINE A. PITROLO
Manager
U.S. Department of Energy, Idaho Operations Office

1/27/94
Date

Signature sheet for the foregoing Pad A located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

Jerry L. Harris

JERRY L. HARRIS
Director
Idaho Department of Health and Welfare

2/17/94
Date

CONTENTS

FIGURES

TABLES

ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BRA	Baseline Risk Assessment
CAM	Continuous Air Monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCA	Consent Order Compliance Agreement
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy, Idaho Operations Office
EA	Environmental Assessment
EBR	Experimental Breeder Reactor
EG&G Idaho	EG&G Idaho, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER&WM	Environmental Restoration and Waste Management
ESRP	Eastern Snake River Plain
FFA/CO	Federal Facility Agreement and Consent Order
FR	Federal Register
IDHW	Idaho Department of Health and Welfare
INEL	Idaho National Engineering Laboratory
LLW	Low-level Waste
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NPV	Net Present Value
NRF	Naval Reactor Facility
NRC	U.S. Nuclear Regulatory Commission
OU	Operable Unit
RCG	Radiation Concentration Guide
RCRA	Resource Conservation and Recovery Act

RFP	Rocky Flats Plant
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
RWMIS	Radioactive Waste Management Information System
SARA	Superfund Amendments and Reauthorization Act
SDA	Subsurface Disposal Area
SF	Slope Factor
SRPA	Snake River Plain Aquifer
TBC	To-Be-Considered
TDA	Transuranic Disposal Area
TRA	Test Reactor Area
TRU	Transuranic
TRA	Transuranic Storage Area
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria
WAG	Waste Area Group
WIPP	Waste Isolation Pilot Plant

DECISION SUMMARY

1. SITE NAME, LOCATION, AND DESCRIPTION

The Idaho National Engineering Laboratory (INEL) is a government facility managed by the U.S. Department of Energy (DOE) located 51.5 km (32 mi) west of Idaho Falls, Idaho, and occupies 2305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEL (Figure 1). Pad A is located in the north-central portion of the Subsurface Disposal Area (SDA) and is approximately 73.2 × 102.1 m (240 × 335 ft). The SDA is a 35.6-ha (88-acre) area located within the RWMC.

Current land use at the INEL is primarily nuclear research and development and waste management. Surrounding areas are managed by the Bureau of Land Management for multipurpose use. The developed area within the INEL is surrounded by a 1295-km^2 (500-mi^2) buffer zone used for cattle and sheep grazing.

Of the 11,700 people employed at the INEL, approximately 100 are employed at the RWMC. The nearest offsite populations are in the cities of Atomic City [19.2 km (12 mi) southeast of RWMC], Arco [25.7 km (16 mi) northwest], Howe [30.6 km (19 mi) north], Mud Lake [58 km (36 mi) northeast], and Terreton [59.5 km (37 mi) northeast].

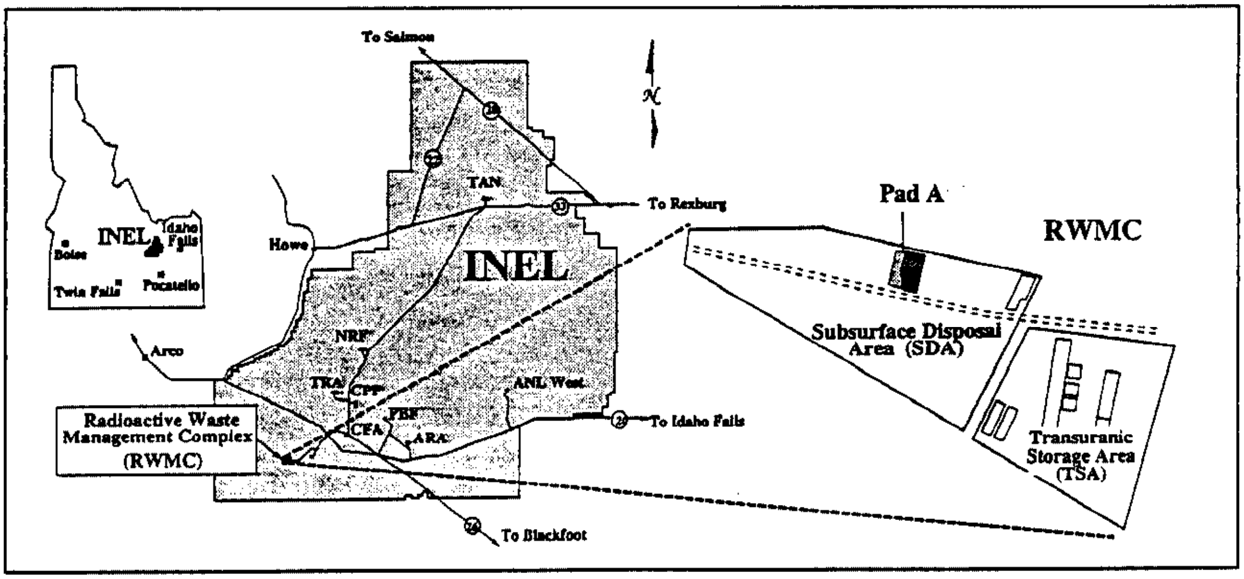


Figure 1. The Radioactive Waste Management Complex at the INEL.

The INEL property is located on the northeastern edge of the Eastern Snake River Plain (ESRP), a volcanic plateau, that is primarily composed of silicic and basaltic rocks and relatively minor amounts of sediment. Underlying the RWMC are series of basaltic lava flows with sedimentary interbeds. The basalts immediately beneath the Site are relatively flat and covered by 6.1 to 9.1 m (20 to 30 ft) of alluvium.

The depth to the Snake River Plain Aquifer (SRPA) underlying the INEL varies from 61 m (200 ft) in the northern portion to 274.3 m (900 ft) in the southern portion of the INEL. The depth to the aquifer at the RWMC is 176.8 m (580 ft). Regional groundwater flow is generally to the southwest.

The INEL has semidesert characteristics with hot summers and cold winters. Normal annual precipitation is 23.1 cm/yr (9.1 in./yr), with estimated evapotranspiration of 15.2 to 22.8 cm/yr (6 to 9 in./yr). The only surface water present at the INEL is the Big Lost River, which is approximately 1.5 mi northwest of the RWMC; however, due to the arid nature of the INEL, this river is typically dry and contains no running water. Surface water is present at the RWMC only during periods of heavy rainfall and snowmelt, which generally occur in January through April.

To minimize the potential for surface water to flow onto the RWMC during periods of high surface water runoff at the INEL, water is diverted from the RWMC via spreading areas and associated dikes, located to the west and south of the RWMC (Figure 2). To further enhance surface water diversion from the pits and trenches, berms have also been constructed immediately around the SDA.

Twenty distinctive vegetative cover types have been identified at the INEL, with big sagebrush the dominant species, covering approximately 80% of ground surface. The variety of habitats on the INEL support numerous species of reptiles, birds, and mammals. Several bird species at the INEL that warrant special concern because of sensitivity to disturbance or their threatened status include the ferruginous hawk (*Buteo regalis*), bald eagle (*Haliaeetus leucocephalus*), prairie falcon (*Falco mexicanus*), peregrine falcon (*Falco peregrinus*), merlin (*Falco columbarius*), long-billed curlew (*Numenius americanus*) and the burrowing owl (*Athlene cunicularia*). The ringneck snake, whose occurrence is considered to be INEL-wide, is listed by the Idaho Department of Fish and Game as a Category C sensitive species.

The RWMC encompasses 58.3 ha (144 acres) [0.59 km^2 (approximately 0.23 mi^2)] and consists of two main disposal and storage areas: (a) Transuranic (TRU) Storage Area and (b) the SDA. Within these areas are smaller, specialized disposal and storage areas.

Approximately 10,200 m^3 (13,341 yds^3) of containerized solid wastes were placed on a 73.2 × 102.1 m (240 × 335 ft) asphalt pad, known as Pad A, at the SDA from September 1972 to August 1978. The asphalt pad is approximately 5.6 to 6.1 cm (2 to 3 in.) thick. The depth from the bottom of the asphalt pad to the underlying basalt ranges from 0.3 to 3.7 m (1 to 12 ft). Pad A presently has a soil cover that averages about 1.2 m (4 ft) thick.

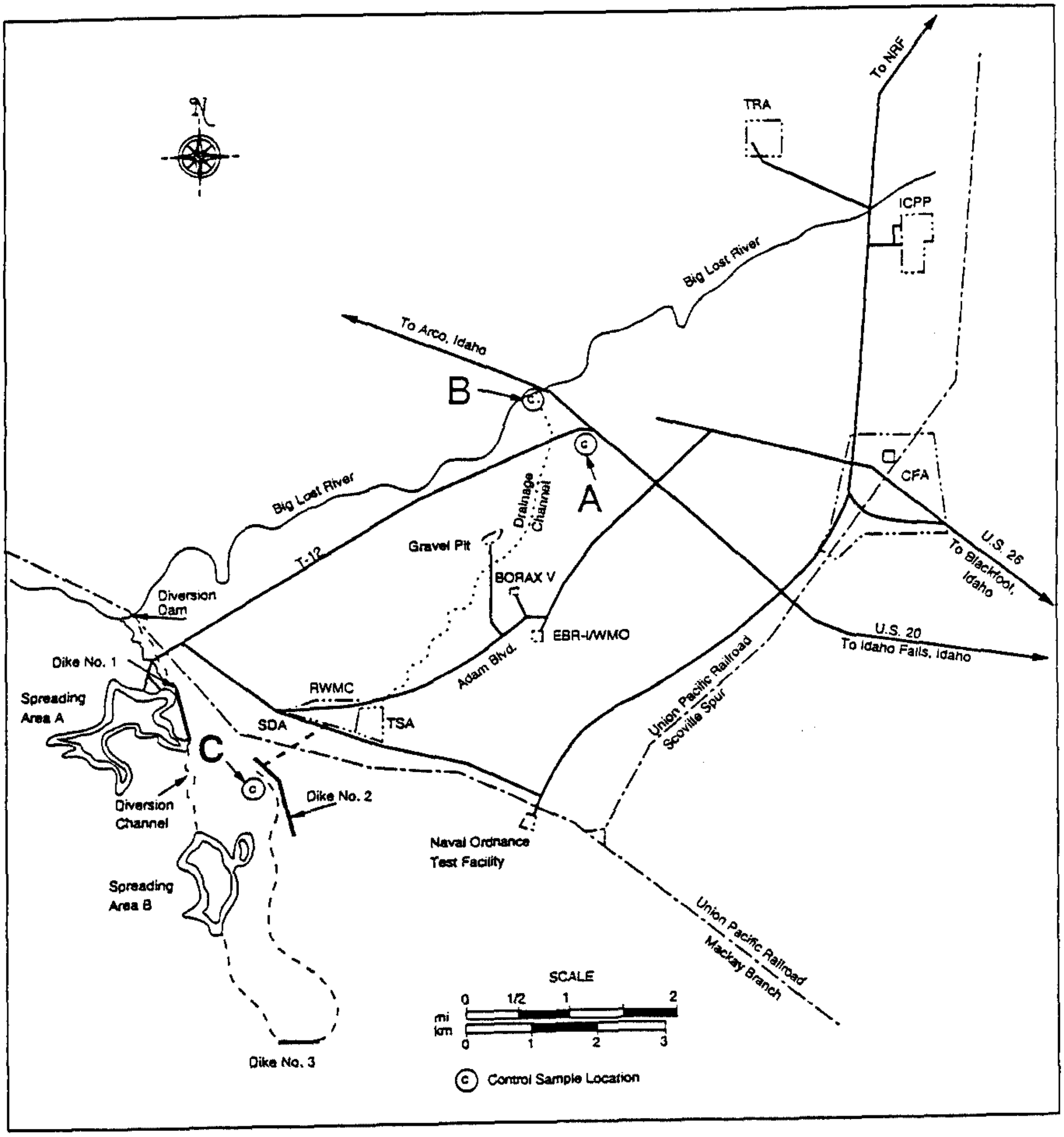


Figure 2. RWMC and associated spreading areas at the INEL.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The RWMC was established in the early 1950s as a disposal site for solid, low-level waste (LLW) generated by INEL operations. Within the RWMC is the SDA where hazardous substances (radioactive and hazardous waste) have been disposed in underground pits, trenches, soil vault rows, and Pad A—an aboveground pad. TRU waste was disposed in the SDA from 1952 to 1970 and was received from the Rocky Flats Plant (RFP) for disposal in the SDA from 1954 through 1970. The RFP is a DOE-owned facility located west of Denver, Colorado, and was used primarily for the production of plutonium components for nuclear weapons. Also located in the RWMC is the Transuranic Storage Area (TSA) where interim storage of TRU waste occurs in containers on asphalt pads. The TSA accepted TRU waste from offsite generators for storage from 1970 through 1988. TRU waste generated at the INEL is still received and stored in the TSA. The location of Pad A within the SDA is shown in Figure 1.

Since 1970, solid TRU waste received at the RWMC has been segregated from non-TRU solid waste and placed into the interim retrievable storage at the TSA. RWMC LLW that is contaminated with TRU isotopes less than or equal to 100 nanocuries per gram (≤100 nCi/g) but greater than 10 nanocuries per gram (>10 nCi/g) is excluded by DOE's Waste Acceptance Criteria (WAC) from disposal at the RWMC and is placed in interim storage at the RWMC. LLW contaminated with TRU isotopes ≤10 nCi/g is disposed of in the SDA. All but two shipments of waste disposed of on Pad A are classified as LLW (i.e., <100 nCi/g); the other two shipments contained waste with TRU radionuclide concentrations >100 nCi/g. One shipment consisted of eight drums with a total loading of 583.2 nCi/g, and the second shipment consisted of two drums with a total loading of 108.6 nCi/g. No waste disposal has occurred on Pad A at the SDA since its closure in 1978.

A Consent Order and Compliance Agreement (COCA) was entered into between DOE and the U.S. Environmental Protection Agency (EPA) pursuant to Resource Conservation and Recovery Act (RCRA) Section 3008(h) in August 1987. The COCA required DOE to conduct an initial assessment and screening of all solid waste and/or hazardous waste disposal units at the INEL, and set up a process for conducting any necessary corrective actions.

On July 14, 1989, the INEL was proposed for listing on the National Priorities List (NPL) [54 *Federal Register* (FR) 29820]. The listing was proposed by the EPA under the authorities granted EPA by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The final rule that listed the INEL on the NPL was published on November 21, 1989, in 54 FR 44184.

As a result of the INEL's listing on the NPL in November 1989, DOE, EPA, and the State of Idaho Department of Health and Welfare (IDHW) entered into the Federal Facility Agreement and Consent Order (FFA/CO) on December 9, 1991.

Pad A was identified for a Remedial Investigation/Feasibility Study (RI/FS) under the FFA/CO. This Record of Decision (ROD) documents the results of the RI/FS and the remedy selected. The entire RWMC will be evaluated in the Waste Area Group (WAG) 7 Comprehensive RI/FS which is scheduled to begin no later than July 1996.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

In accordance with CERCLA § 113(k)(2)(B)(i-v) and 117, a series of opportunities for public information and participation in the remedial investigation and decision process for Pad A were provided over the course of 21 months beginning in November of 1991 and continuing through August 1993. For the public, the activities ranged from receiving a fact sheet, *INEL Reporter* articles and updates, and a proposed plan, to having a telephone briefing, four public scoping meetings, three public meetings, and two open houses to offer verbal or written comments during two separate 30-day public comment periods.

On November 19, 1991, a fact sheet concerning Pad A was conveyed through a "Dear Citizen" letter to a mailing list of 5,600 individuals of the general public and 11,700 INEL employees in advance of the public scoping meetings scheduled in early December. On November 20, the DOE issued a news release to more than 40 news media contacts concerning the beginning of a 30-day public scoping comment period, which ended January 3, 1992, on the Pad A remedial investigation. Both the letter and release gave notice to the public that Pad A documents would be available before the beginning of the comment period in the Administrative Record section of the INEL Information Repositories located in the INEL Technical Library of Idaho Falls, as well as in city libraries in Idaho Falls, Pocatello, Twin Falls, Boise, and Moscow. Display ads announcing the same information appeared in eight major Idaho newspapers. Large ads appeared in the following newspapers from November 22 to the 27: *Post Register* (Idaho Falls); *Idaho State Journal* (Pocatello); *South Idaho Press* (Burley); *Times News* (Twin Falls); *Idaho Statesman* (Boise); *Idaho Press Tribune* (Nampa); *Lewiston Morning Tribune* (Lewiston); and *Idahonian* (Moscow).

Similar display ads concerning upcoming meetings appeared in each of these newspapers several days preceding each local meeting to encourage citizens to attend and provide verbal or written comments. All three media—the Dear Citizen letter, news release, and newspaper ads—gave public notice of four scoping meetings concerning the beginning of the investigation at Pad A and the beginning of a 30-day public comment period that was to begin December 4, 1991. Additionally, two radio stations in Idaho Falls and newspapers in Idaho Falls and other communities repeated announcements from the news release to the public at large. A total of seven radio advertisements were made by local stations where meetings were scheduled several days before and the day of the meetings.

Personal phone calls concerning the availability of Pad A documents and public meetings were made to individuals, environmental groups, and organizations by INEL Outreach Office staff in Pocatello, Twin Falls, and Boise. The Community Relations Plan Coordinator made calls in Idaho Falls and Moscow.

Scoping meetings on Pad A were held in conjunction with scoping the remedial investigation of the organic contamination in the vadose zone, and an informational discussion on the Pit 9 proposed plan, all of which were projects from WAG 7 at the RWMC. The meetings were held December 9, 10, 11, and 12, 1991 in Boise, Moscow, Twin Falls, and Idaho Falls respectively. An informal open house was held one hour prior to each of the meetings to allow the public to visit with State and Federal representatives about Pad A.

During the meetings that followed, representatives from DOE and INEL discussed the project, answered both written and verbal questions, and received public comments. Written comment forms were distributed at the meetings. Comments from the scoping meetings were evaluated and considered as part of the RI/FS process.

Regular reports concerning the status of the Pad A project were included in the *INEL Reporter* and mailed to those who attended the meetings and who were on the mailing list. Reports appeared in the March, May, July, and November 1992; and the January, March, and July 1993 issues of the *INEL Reporter*. During this time the number of individuals on the mailing list increased to 6,600. Individuals on the mailing list, those who attended the meetings, and all INEL employees received issues of the *INEL Reporter*.

Opportunities for public involvement in the decision process for Pad A were provided beginning in July 1993. For the public, the activities ranged from receiving the proposed plan, conducting one teleconference call, and attending open houses and public meetings to informally discuss issues and offer verbal and written comments to the agencies during the 30-day public comment period.

On July 19, 1993, DOE-ID issued a news release to more than 40 news media contacts concerning the beginning of a 30-day public comment period on the Pad A proposed plan. The release also gave notice to the public that Pad A documents would be available before the beginning of the comment period in the Administrative Record section of the INEL Information Repositories located in the INEL Technical Library in Idaho Falls, the Shoshone-Bannock Library at Fort Hall, the University of Idaho Library in Moscow, the Idaho State Library in Boise; as well as in city libraries in Idaho Falls, Pocatello, Twin Falls, Boise, and Moscow.

Copies of the proposed plan for Pad A were mailed to 6,600 individuals on the INEL Community Relations Plan mailing list on July 28, 1993 urging citizens to comment on the plan and to attend public meetings. Display ads announcing the same information and the location of open houses in Pocatello and Twin Falls, and public meetings in Idaho Falls, Boise, and Moscow appeared in seven major Idaho newspapers. Large ads appeared in the following newspapers from July 15 to 20: *Post Register* (Idaho Falls), *Idaho State Journal* (Pocatello), *South Idaho Press* (Burley), *Times News* (Twin Falls), *Idaho Statesman* (Boise), *Lewiston Morning Tribune* (Lewiston), and *The Daily News* (Moscow).

Similar display ads concerning upcoming meetings appeared in each of these newspapers several days preceding each local open house or meeting to encourage citizens to attend and provide verbal or written comments. Both media, the news release and newspaper ads, gave public notice of public involvement activities and offerings for briefings, and the beginning of a 30-day public comment period that was to begin July 28 and run through August 26, 1993. Additionally, radio stations in Idaho Falls, Blackfoot, Pocatello, Burley, and Twin Falls ran advertisements during the three days prior to the open houses in Pocatello and Twin Falls.

The open houses were held in Pocatello and Twin Falls on August 11 and 12, and the public meetings were held in Idaho Falls, Boise, and Moscow on August 17, 18, and 19, 1993. Written comment forms, including a postage-paid business reply form, were made available to those attending the meetings. The forms were used to turn in written comments at the meeting, and by some, to mail in comments later. The reverse side of the meeting agenda contained a form for the public to evaluate the effectiveness of the meetings. A court reporter was present at each meeting to keep a verbatim transcript of discussions and public comments. The meeting transcripts were placed in the Administrative Record section for Pad A, Operable Unit 7-12, in eight INEL Information Repositories.

On August 10, 1993, a teleconference call between the League of Woman Voters of Moscow and the Environmental Defense Institute, DOE-ID, EPA, and the IDHW concerning the Pad A proposed plan was conducted at the request of Moscow area residents. The call consisted of an overview of the proposed plan, questions and answers, and general discussion of Pad A issues.

Personal phone calls concerning the availability of the proposed plan and the public meetings were made to individuals, environmental groups, and organizations by the INEL Community Relations Plan Coordinator. Outreach Office staff made calls to citizens in northern, southwestern, and southeastern Idaho.

Another series of ads were placed in the same local papers several days before the public meetings to encourage citizens to attend and comment on the plan. Additionally, a special feature article in the July issue of the *INEL Reporter* was mailed to 6,600 individuals to remind citizens about the meetings and the opportunity to comment on the proposed plan.

A Responsiveness Summary has been prepared as part of the Record of Decision. All formal verbal comments, as given at the public meetings, and all written comments, as submitted, are repeated verbatim in the Administrative Record for the Record of Decision. Those comments are annotated to indicate which response in the Responsiveness Summary addresses each comment.

A total of 42 people attended the Pad A public meetings. Overall, 22 provided formal comments; of these 22 people, 10 people provided oral comments and 12 people provided written comments. This resulted in a total number of 109 comments. All comments received on the proposed plan were considered during the development of this ROD. The decision for this action is based on the information in the Administrative Record for this operable unit (OU).

4. SCOPE AND ROLE OF OPERABLE UNIT AND RESPONSE ACTION

Under the FFA/CO, the INEL is divided into ten WAGs. The WAGs are further divided into OUs. The RWMC has been designated WAG 7 and consists of 14 OUs. Data from shipping records, along with process knowledge, written correspondence, and existing monitoring data, were available to allow Pad A to be evaluated in an expedited manner. Therefore, Pad A was designated as an OU to accelerate a RI/FS. Pad A, OU 7-12, consists of the asphalt pad, the waste pile, and the overlying soil cover.

A complete evaluation of all cumulative risks associated with CERCLA actions at WAG 7 will be conducted as part of the WAG 7 Comprehensive RI/FS (OU 7-14) to ensure all risks have been adequately evaluated. Conducting this remedial action is part of the overall WAG strategy and is expected to be consistent with any planned future actions.

5. SUMMARY OF SITE CHARACTERISTICS

Pad A was constructed in 1972 for disposal of packaged solid mixed waste (hazardous waste contaminated with radioactive material) primarily from the Rocky Flats Plant in Colorado. The waste was packaged in 18,232 55-gal drums, and 2,020 4 × 4 × 7 ft plywood boxes which were placed at Pad A from September 1972 until August 1978. Each container had at least one polyethylene liner, with most containing double liners. Waste was carefully stacked on the pad with the drums reaching a maximum of 11 high, and boxes stacked a maximum of 5 high (Figure 3). At the completion of container placement activities, approximately 40% of the total pad area was occupied by waste materials.

Closure of Pad A was performed by placing plywood and/or polyethylene over the exposed containers. Both types of covering were placed in some areas, and other areas had no covering. The waste pile was then covered with a soil layer 0.9 m (3 ft) to 1.8 m (6 ft) in thickness (Figure 4). After the cover was completed, the area was seeded with crested wheatgrass to minimize soil erosion.

Environmental monitoring has been conducted to detect contaminant migration from Pad A since 1978 and has included the monitoring of surface water, groundwater, soil, and biota. Although these monitoring activities were conducted as part of routine monitoring activities at the RWMC, no conclusive trends for contaminant migration were identified for Pad A.

In addition to the environmental monitoring program, investigations of Pad A wastes were conducted prior to the initiation of FFA/CO activities. This included an investigation between September 26 and October 12, 1979, to determine the condition of the buried drums and plywood boxes. Another investigation in 1989 included determining the extent of radiological contamination on the external surfaces of the uncovered drums. Results of laboratory counts did not indicate that radioactive contamination was present on or near the drums. This investigation also involved surveying for volatile organic compounds (VOCs) and sampling for beryllium and nitrates. The intent of these programs was to determine whether any gross migration of contaminants or large-scale failure of the cover was occurring at Pad A.

The composition of Pad A wastes was identified based on written correspondence and process knowledge from the RFP, the major source of Pad A wastes, as well as information from RFP shipping and INEL disposal records contained in the Radioactive Waste

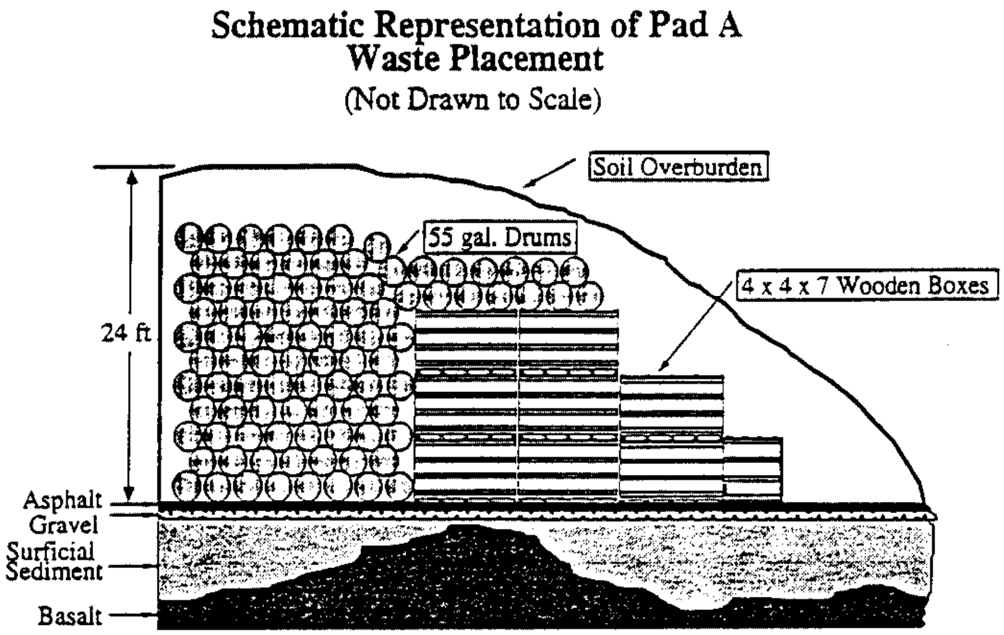


Figure 3. Schematic representation of Pad A waste placement.

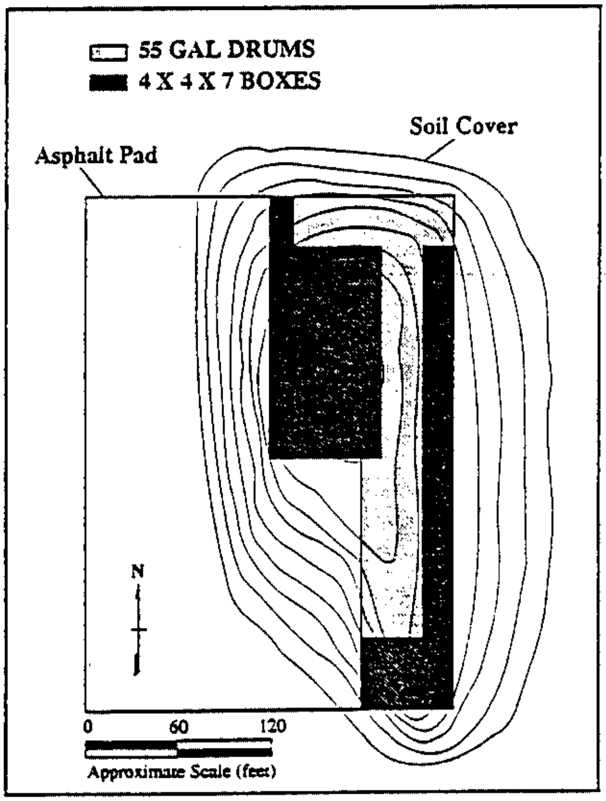


Figure 4. Pad A plan view.

Management Information System (RWMIS). The RWMIS was initiated in 1971 and is considered to be the official INEL record for solid radioactive wastes.

Pad A wastes are primarily composed of nitrate salts, depleted uranium waste, and sewer sludge. Wastes, totaling approximately 10,200 m^3 (13,341 yd^3), at Pad A consist of:

- Approximately 7,250 m^3 (9,483 yd^3) of evaporator salts from the RFP contaminated with transuranic radionuclides

- Approximately 2,250 m^3 (2,943 yd^3) of waste consisting primarily of oxides of uranium, uranium casting wastes, beryllium foundry wastes, and machining wastes from RFP (hereinafter referred to as depleted uranium and beryllium foundry wastes)

- Dry sewage sludge from the RFP contaminated with low levels of TRU radionuclides

- Miscellaneous INEL-generated radioactive wastes such as lab waste, counting sources, and uranium standards.

The evaporator salts are primarily sodium nitrate and potassium nitrate (60% sodium nitrate, 30% potassium nitrate, 10% miscellaneous). The nitrates at Pad A have been reviewed against 40 Code of Federal Regulations (CFR) 261.21(a)(4) and 49 CFR 173.151 and appear to exhibit the properties of an oxidizer. It is recognized that this type of oxidizer can have the characteristic of ignitability. Radioactive contamination includes plutonium, americium, thorium, uranium, and potassium-40.

Miscellaneous wastes at Pad A include other inorganic salts, dirt, concrete, and other materials. Approximately 4,600,000 kg (10,143,000 lbs) of inorganic salts from Rocky Flats are contained in 1,275 plywood boxes and 15,400 drums according to information from the RWMIS. The total inorganic salt waste consists of approximately 60% sodium nitrate ($NaNO_3$), 30% potassium nitrate (KNO_3), and 10% chloride, sulfate, and hydroxide salts. Based on RWMIS information, the volume of salts in the containers noted above comprises 71% of the total waste volume in Pad A.

Using RWMIS data, the depleted uranium waste received from RFP comprises approximately 2,250 m^3, which is 22% of the total waste volume stored in Pad A. The remaining 7% of the total waste volume is made up of the miscellaneous wastes and sludges. The chemical form and mass of the chemical contaminants on Pad A are shown in Table 1. The mass of uranium is based on 72,400 kg (159,642 lb) of total uranium, which is derived from the specific radioactivity of the three uranium isotopes listed in Table 2. This number is then converted to the triuranium octaoxide (U_3O_8) chemical mass. The U_3O_8 chemical form is the stable oxide form from uranium that was incinerated at the RFP before shipment to INEL.

Table 1. Estimated chemical masses in Pad A.

Chemical	Mass (kg)	Mass (lb)
Sodium nitrate ($NaNO_3$)	2.7E+06	5.95E+06
Potassium nitrate (KNO_3)	1.4E+06	3.09E+06
Sodium chloride (NaCl)	1.0E+05	2.20E+05
Potassium chloride (KCl)	5.1E+04	1.12E+05
Sodium sulfate (Na_2SO_4)	1.0E+05	2.20E+05
Potassium sulfate (K_2SO_4)	5.1E+04	1.12E+05
Sodium hydroxide (NaOH)	1.0E+05	2.20E+05
Potassium hydroxide (KOH)	5.1E+04	1.12E+05
Triuranium octaoxide (U_3O_8)	8.75E+04	1.93E+05

Table 2 displays the specific radioactivity for each radionuclide in curies on an annual basis from 1972 to 1978. The data used are those supplied by individual shipping records from the RFP that were entered into the RWMIS. The annual data listed for each radionuclide represent total quantities received for each year without decay corrections during that year. The total radioactivity for each radionuclide from 1972 to 1978 is displayed without any decay corrections. The total of nuclide radioactivity in curies from the RWMIS is 3.892E+01.

5.1 Summary of Environmental Monitoring Data

Sampling and monitoring activities of Pad A were conducted prior to the initiation of any FFA/CO investigations. Based on the evaluation of these data, no additional sampling was required to complete the Pad A remedial investigation. Rather, the Pad A investigation in effect consisted of the reconstruction and documentation of existing records and data.

5.1.1 Surface Water

Monitoring of surface water at Pad A began in 1974, when surface water samples were collected from water standing on Pad A. Also commencing in 1974, samples were collected from the Pad A drainage ditch (see Figure 5) and analyzed by gamma spectroscopy. This sampling and analytical program continued through 1975. From 1976 through 1981, surface water samples were collected annually from the Pad A culvert and were analyzed for gross alpha and gross beta in addition to gamma spectroscopy. Sampling of the Pad A culvert continued until 1986. Because monitoring of surface water at Pad A was conducted after periods of rainfall or snowmelt, there was no set frequency for surface water sample collection. Overall the Pad A surface water samples were consistent with or were within the range of the control values taken, and the data do not confirm or refute the leaching of nitrates or radionuclides from Pad A waste.

Table 2. Pad A specific nuclide radioactivity by year in curies from RWMIS.

Radionuclide	Half-Life (yr)	1972	1973	1974	1975	1976	1977	1978	Total
K-40[a]	1.277E+09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.200E-01
TH-232	1.405E+10	0.00	0.00	2.779E-05	1.090E-07	0.00	0.00	0.00	2.790E-05
U-234	2.450E+05	0.00	0.00	1.123E-05	0.00	0.00	0.00	0.00	1.123E-05
U-234'[b]	2.450E+05	7.281E-01	1.342E+00	1.393E+00	1.439E+00	4.853E-01	9.160E-01	7.775E-01	7.080E+00
U-235	7.038E+08	3.317E-02	6.114E-02	6.345E-02	6.554E-02	2.211E-02	4.173E-02	3.542E-02	3.226E-01
U-238	4.468E+09	2.672E+00	4.680E+00	4.873E+00	5.206E+00	1.638E+00	3.111E+00	2.768E+00	2.495E+01
PU-238	8.774E+01	2.572E-04	1.462E-03	1.910E-02	1.379E-03	6.109E-03	1.483E-04	2.017E-04	2.866E-02
PU-239	2.412E+04	7.301E-03	8.756E-02	5.423E-01	3.933E-02	1.735E-01	4.585E-03	6.562E-03	8.611E-01
PU-240	6.570E+03	1.656E-03	6.916E-02	1.230E-01	8.938E-03	3.934E-02	1.089E-03	1.603E-03	2.448E-01
PU-241	1.435E+01	4.389E-02	2.495E-01	3.259E+00	2.392E-01	1.043E+00	2.895E-02	5.281E-02	4.916E+00
PU-242	3.763E+05	1.182E-07	6.720E-07	8.779E-06	6.358E-07	2.808E-06	6.232E-08	1.018E-07	1.318E-05

a. The K-40 radioactivity is based on the mass of natural potassium in Pad A.

b. U-234' is U-234 that is calculated from the presence of U-235. It is not automatically listed in the RWMIS database.

GRAND TOTAL: 3.892E+01

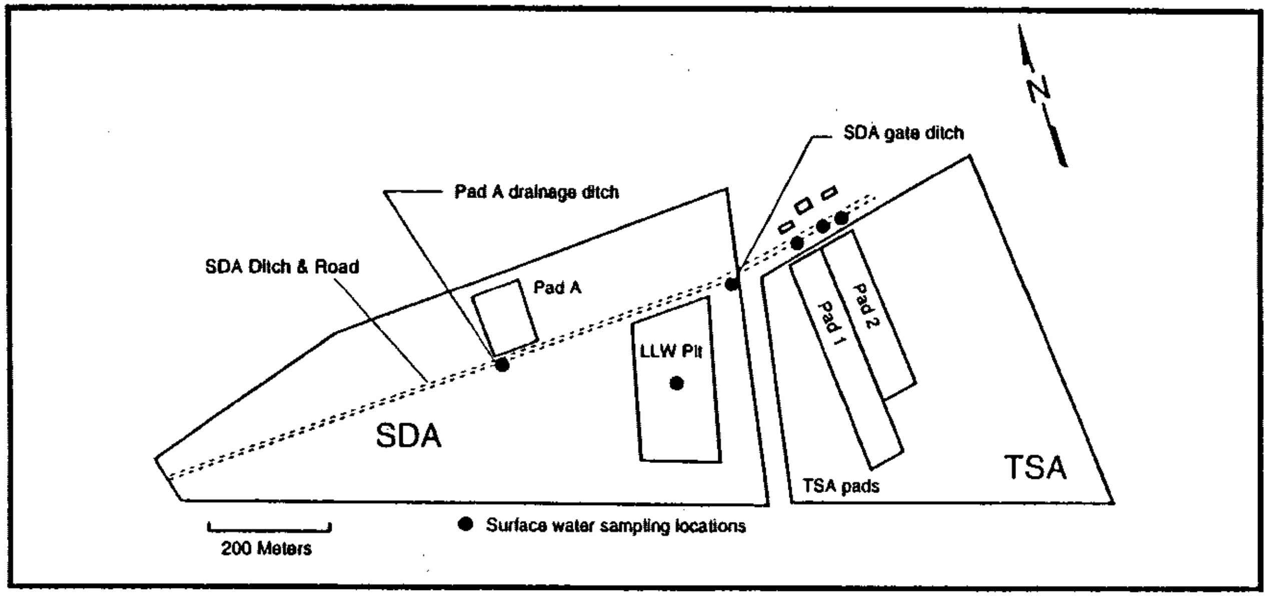


Figure 5. TSA/SDA surface water sampling locations.

Radionuclides

Between 1974 and June 2, 1982, 46 surface water samples were collected from the Pad A drainage ditch (Figure 5) and were analyzed by gamma spectroscopy. Cs-137 was detected in 19 of the 46 samples; the mean concentration of Cs-137 in these 19 samples was 1.1×10^{-8} µCi/mL.

Commencing in 1976, the surface water samples were also analyzed for gross alpha and gross beta. Between 1976 and June 1982, 39 water samples were analyzed for gross alpha and gross beta. Gross alpha activity was observed in 4 of the 39 water samples; however, none of the concentrations exceeded the DOE Radiation Concentration Guide (RCG) for gross alpha activity in surface water (3×10^{-8} µCi/mL). The RCG was the allowable activity of a radionuclide in a specific media in an area where public access is allowed.

Gross beta activity was detected in 34 of 39 samples, but again, none of the samples exceeded the RCG for gross beta activity in place at that time (i.e., 3×10^{-7} µCi/mL).

Analytical results for surface water samples taken from the Pad A culvert in 1980 and 1982 are provided in Table 3. Table 4 presents the analytical results at Pad A from 1983 to 1985. Surface water samples for radionuclides at Pad A were not taken in 1981.

Nonradiological Contaminants

Analysis of surface water from the Pad A culvert for nitrates commenced in 1980 and concluded in 1986. The analytical results for these surface water samples are summarized in Table 5. The nitrate concentrations ranged from 0.08 ppm to 28 ppm.

5.1.2 Soil

Radiological sampling of Pad A soils began in 1984. Analysis included gamma spectroscopy and radiochemistry for Pu-238, -239, U-235, -238, Am-241, and Sr-90. Nitrate sampling commenced in 1979 and concluded in 1984. Samples were normally taken in the spring and fall. Nitrate concentrations collected from Pad A were consistent with nitrate concentrations of control samples outside of the RWMC.

Radionuclides

Routine sampling of the Pad A soil cover for radionuclides began in 1984. Sample locations are presented in Figure 6. Each sample location was $10 \times 10\text{-m}^2$, and samples were collected from each corner of the square and from the center. The composite samples ranged from a depth of 0 to 2 in. The samples were then combined to form one composite sample to represent the entire sample location. Analysis of the samples included gamma spectroscopy and radio chemistry for Pu-238, -239, -240 and U-235, -238, Am-241 and Sr-90. Analytical results of specific radionuclide analyses taken in 1984, 1986, and 1988 are presented in Table 6.

Table 3. Surface water results at the Pad A from 1980 and 1982.

Year	Type	Location (if known)	Samples collected (if known)	Measured concentration (10^{-8} µCi/mL) Minimum (if known)	Mean (if known)	Maximum (if known)
1980	Gross Beta					
		TDA (Pad A) Ditch	3 total samples 2 positive	2.2 ± 0.5	NDR[a]	3.8 ± 1.1
		Big Lost River (control)[b]	5	NDR	NDR	BDL-GB[1980 c]
1982	Gross Alpha	Pad A ditch	6	See maximum	NDR	BDL-GA[1982 d]
	Gross Beta	Pad A ditch	6	NDR	Average value was 3 times the control samples[e]	NDR
	Gamma-Cs-137	Pad A ditch	6 samples collected 2 positive	NDR	NDR	0.75 ± 0.29
	Gamma-Nb-95	Pad A ditch	6 samples collected 1 positive	NDR	NDR	0.8 ± 0.18
	Gamma-Ru-106	Pad A ditch	6 samples collected 1 positive	NDR	NDR	3.2 ± 1.1
	Gamma-Ag-110	Pad A ditch	6 samples collected 1 positive	NDR	NDR	0.67 ± 0.23

a. No data recorded.

b. Before 1983, control samples were collected from the Big Lost River, approximately 20 mi northwest of the RWMC.

c. BDL-GB[1980] = Below 1980 Gross Beta Detection Limit 3.0×10^{-8} µCi/mL.

d. BDL-GA[1982] = Below 1982 Alpha Detection Limit 3.0×10^{-9} µCi/mL.

e. The control sample (i.e., background) and location sample values were not included in the 1982 annual environmental surveillance report.

Table 4. Surface water results at Pad A from 1983 to 1985.

Date of collection	Sampling location	Radionuclide	Unfiltered[a,b,c] activity (10^{-8} µCi/mL)	Particulate[a,b] activity (10^{-8} µCi/mL)
07/06/83	Pad A[d]	Cs-137	96.04 ± 1.48	22.26 ± 0.53
	Control[e]	No water available	No water available	No water available
07/11/83	Pad A	Cs-137	0.62 ± 0.08	NDR[f]
11/17/83	Pad A	Only NOR[g]	NDR	NDR
	Control	Only NOR	NDR	NDR
3/14/84	Pad A	Only NOR	NDR	NDR
06/19/84	Pad A	Cs-137	0.37 ± 0.085	Not analyzed
07/25/84	Pad A	Only NOR	NDR	NDR
10/25/84	Pad A	Am-241	0.014 ± 0.0005	Not analyzed
	Control	Pu-239, -240 Am-241 Total U	0.009 ± 0.004 0.06 ± 0.02 0.01 ± 0.01	Not analyzed Not analyzed Not analyzed
04/01/85	Pad A	Only NOR	NDR	NDR
	Control	Only NOR	NDR	NDR
05/15/85	Pad A	Total U	Not detected	0.08 ± 0.01
	Control	Only NOR	NDR	NDR
07/17/85	Pad A	Only NOR	NDR	NDR
	Control	Cs-137	1.7 ± 0.2	2.4 ± 0.2

a. Replicate samples were collected from many locations; therefore, multiple concentrations for a single radionuclide at a single location may be noted.

b. Results include an analytical uncertainty of ± 1 standard deviation.

c. Because the water samples re-acidified before filtration, radionuclides originally ion-exchanged or physically sorbed onto suspended solids may have been solubilized to some degree. Thus, the radionuclide concentration in the liquid may be higher than that which exists in the environment. Likewise, the radionuclide concentration in the particulate portion may be lower than in the environment.

d. Values obtained for these samples were the results of a spill within the RWMC and are not representative of normal conditions. The higher than normal values obtained for cesium and strontium on these dates resulted from spread of contamination within the SDA by leakage from a nonstandard waste box. The box was temporarily stored on Pad A. Contaminants were washed from the bed of the transport trailer onto Pad A and carried into and down the drainage ditch located on the south side of the main SDA road. After cleanup efforts the Pad A ditch sample showed reduced levels of contamination (see July 11 Pad A sample results).

e. Beginning in 1983 control samples were collected at a location approximately 3 mi northeast of the RWMC where surface water accumulates after precipitation.

f. No data recorded.

g. Naturally occurring radionuclides.

Table 5. Nitrate concentrations in Pad A runoff water (1980 to 1986).[a]

Location	Year	Concentration (ppm)
Pad A Ditch	1980	2.5–Ave. of 4 samples
Control		0.86–Taken from the Big Lost River
Pad A Ditch	1981 – April[b]	0.5 (average of 3)
Control	– April[b]	1.2–Taken from the Big Lost River
Control	– September	0.6–Taken from the Big Lost River
Pad A Ditch	1982 – March	0.08
Control	– March	0.07–Taken from the Big Lost River
Pad A Ditch	– September	4.7
Control	– September	1.8–Taken from the Big Lost River
Pad A Ditch	1983 – March	2.1
Control	– March	1.4[c]
Pad A Ditch	– May	28
Control	– May	28[c]
Pad A Ditch	– June	3.0
Control	– June	33.5[c]
Pad A Ditch	– July	5.5
Control	– July	No water available
Pad A Ditch	– December	2.0
Control	– December	4.8[c]
Pad A Ditch	1984 – March	3
Control	– March	3[c]
Pad A Ditch	– May	1[d]
Control	– May	69[c]
Pad A Ditch	– July	0.5[d]
Control	– July	3[c]
Pad A Ditch	– December	4
Control	– December	13[c]
Pad A Ditch	1986 (maximum results)[e]	2.2 ± 0.1
Control[f]		2.7 ± 0.2

a. No 1985 water sample nitrate results was published (annual report).

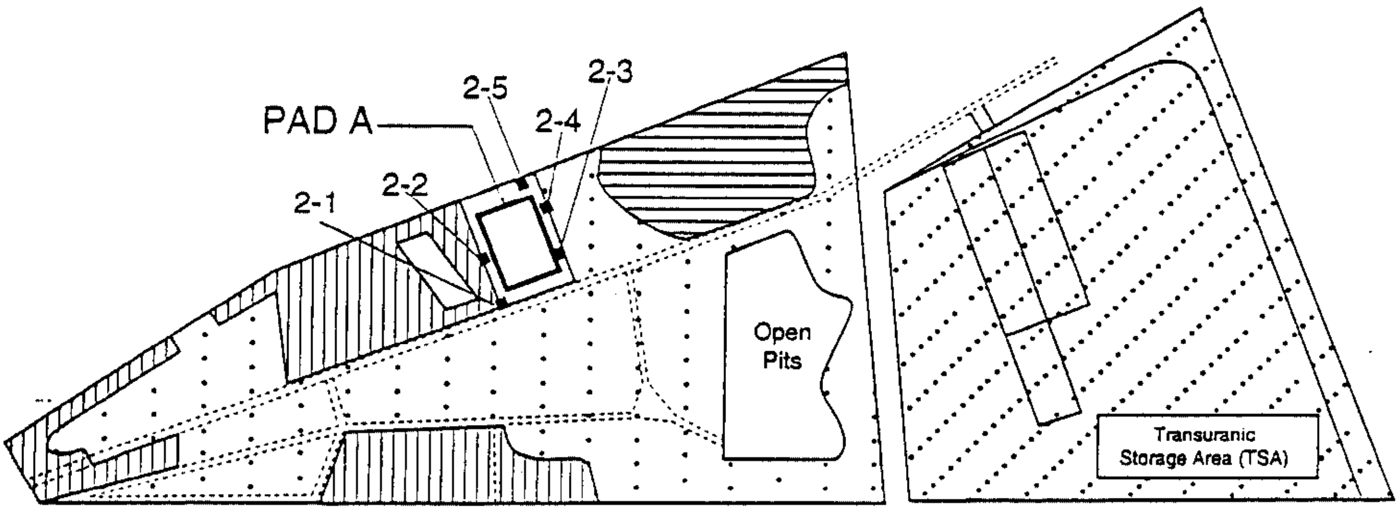
b. Reported in the 1981 annual report as single April values; however, these results appear to be the averages of three samples. The actual sample dates were not reported.

c. Control samples (i.e., background) collected approximately 3 mi northeast of the RWMC.

d. Below the detection limit.

e. The only value published in the 1986 annual report was the maximum result.

f. Control taken from a collection system on top of Pad A.



Location	General Reference	Coordinates	
2-1	South End of Pad A Culvert	N.669,417.15	E.266,945.91
2-2	West Side of Pad A	N.669,730.66	E.266,905.16
2-3	Southeast, mid-slope	N.669,637.25	E.267,075.43
2-4	Northeast, bottom of slope	N.669,756.97	E.267,128.78
2-5	North, bottom of slope	N.669,832.36	E.267,005.50

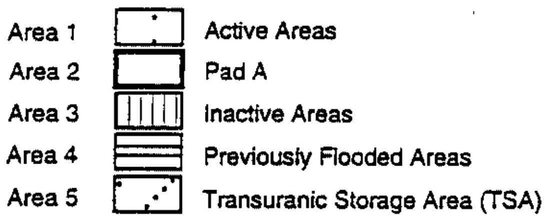


Figure 6. Pad A sampling locations and designated RWMC areas for soil.

Table 6. Activity concentrations in Pad A soils (1984 to 1988).

Year	Location (if known)	Pu-238 activity 10^{-6}(μCi/g)	Pu-239,240 activity 10^{-6}(μCi/g)	Am-241 activity 10^{-6}(μCi/g)	U-234 activity 10^{-6}(μCi/g)	U-235,238 activity 10^{-6}(μCi/g)	Co-60 activity 10^{-6}(μCi/g)	Cs-137 activity 10^{-6}(μCi/g)	Sr-90 activity 10^{-6}(μCi/g)
1984	2-1–2-5	NR[a]	<.2[b]	<.6[b]	NR	NR	Neg. data	<.6[b]	<.8[b]
	Control	NR	<.1	≈.6[c]	NR	NR	≈.3	.9	≈.11
1986	2-1	NR	.42 ± .06	.71 ± .04	.6 ± .1	NR	NR	.39 ± .11	NR
	Unknown	NR	.36 ± .03	.5 ± .1	.5 ± .1	NR	NR	NR	NR
	2-4S[d]	NR	—[e]	.15 ± .01	.6 ± .1	NR	NR	NR	NR
	2-5	NR	—[e]	.14 ± .01	.5 ± .1	NR	NR	.9 ± .02	NR
	2-4	NR	.13 ± .02	.36 ± .03	NR	NR	NR	NR	NR
	Control	NR	.09 ± .02	.44 ± .05	.6 ± .1	NR	NR	NR	NR
	Control	NR	.08 ± .02	.39 ± .04	.6 ± .1	NR	NR	NR	NR
	Control	NR	—[e]	—[e]	.4 ± .1	NR	NR	NR	NR
	Control	NR	—[e]	—[e]	—[e]	NR	NR	NR	NR
1988	2-1	—[e]	.62 ± .006	.97 ± .09	NR	NR	NR	NR	.24 ± .05
	2-1S	.018 ± .006	.9 ± .1	.1 ± .09	NR	NR	NR	NR	—[e]
	2-2	—[e]	.016 ± .006	.14 ± .02	NR	NR	NR	NR	—[e]
	2-2	—[e]	.017 ± .004	.03 ± .006	NR	NR	NR	NR	—[e]
	2-2	—[e]	.022 ± .005	.03 ± .006	NR	NR	NR	NR	—[e]
	2-3	—[e]	.31 ± .03	.63 ± .06	NR	NR	NR	NR	—[e]
	2-3	—[e]	.29 ± .03	.68 ± .07	NR	NR	NR	NR	—[e]
1988	2-4	—[e]	.022 ± .005	.1 ± .01	NR	NR	NR	NR	—[e]
	2-4	—[e]	.018 ± .004	.08 ± .01	NR	NR	NR	NR	—[e]
	Control	—[e]	—[e]	.01 ± .006	NR	NR	NR	NR	.54 ± .07
	Control	—[e]	.039 ± .006	.05 ± .01	NR	NR	NR	NR	.49 ± .08
	Control	—[e]	.013 ± .004	.014 ± .005	NR	NR	NR	NR	.33 ± .08

Table 6. (continued).

Year	Location (if known)	Pu-238 activity 10^{-6}(μCi/g)	Pu-239,240 activity 10^{-6}(μCi/g)	Am-241 activity 10^{-6}(μCi/g)	U-234 activity 10^{-6}(μCi/g)	U-235,238 activity 10^{-6}(μCi/g)	Co-60 activity 10^{-6}(μCi/g)	Cs-137 activity 10^{-6}(μCi/g)	Sr-90 activity 10^{-6}(μCi/g)
1988	Pad A—no specific location identified	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	NR	.246 ± .026	Gamma spec.
	Control	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	NR	.150 ± .06	Gamma spec.
	Control	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	NR	.191 ± .06	Gamma spec.
	Control	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	Gamma spec.	NR	.131 ± .006	Gamma spec.

a. Not reported. No values were given in annual surveillance reports or no evaluation was made for the radionuclide.

b. This value is the mean of samples collected from all Pad A locations. The reported value was taken from the 1984 annual RWMC surveillance report. The information was published in bar graph form. The values reported in this table are interpreted from the bar graphs.

c. ≈6 indicates that the value was interpreted as approximately 6.

d. S indicates a sample split.

e. "-" indicates that the activity for the radionuclide is below the limit of detection.

Nonradiological Contaminants

Nitrate monitoring of the Pad A soil cover commenced in 1979 with the collection of five samples. Routine nitrate sampling of the Pad A soil cover commenced in 1980 and concluded in 1984. This program consisted of collecting five samples twice a year, normally the spring and fall. The sampling and control locations are shown in Figure 7 and results are presented in Table 7.

5.1.3 Groundwater

Monitoring for nitrates in groundwater has been periodically conducted at the INEL for many years. Some concentrations were observed in 1952 to 1970 to be as high as 20 mg/L in the northeast corner of the INEL south of Terreton, Idaho. The Maximum Contaminant Level (MCL) for nitrate is 45 mg/L. Possible recorded sources of the high nitrate concentrations were chemical and organic fertilizers and sewage disposal.

In 1988, nitrate concentrations in water from United States Geological Survey (USGS) Wells 88 (approximately 500 m south of the RWMC) and 89 (approximately 500 m west of the RWMC) were 7.5 and 8.0 mg/L, respectively (Figure 8). These are very similar to concentrations found at other facilities at the INEL [e.g., Test Reactor Area (TRA), Naval Reactor Facility (NRF)]. At TRA, concentrations ranged from 5.3 to 6.6 mg/L. Nitrates at NRF contained 8.0 mg/L.

Data obtained in 1992 from RWMC monitoring wells M1S, M3S, M6S, M7S, M10S, and M4D (Figure 8) were evaluated. The 1992 nitrate concentrations in groundwater collected from RWMC perimeter wells ranged from a low of 2.1 mg/L in Well M7S to a high of 6.0 mg/L in Well M10S.

5.1.4 Biotic

Transport from radioactive waste to biota at the SDA has been quantified through collection and analysis of vegetation, small mammals, and soil samples from excavation of mammal burrows. The routine biotic sampling program at the RWMC began in 1984 with the collection of vegetation and excavated soils. The routine sampling for radioactivity in small mammals began in 1985, when deer mice were collected for analyses.

Results of sampling and analysis for radioactivity in small mammals were obtained from various locations within the RWMC beginning in 1985. Several species including deer mice and ground squirrels were collected during the reporting periods; however, these species were collected over the RWMC as a whole and were composited. Therefore no data specifically pertaining to Pad A are available.

Vegetation

In 1984, samples of crested wheatgrass and Russian thistle were taken from Pad A. Cs-137 was detected in the Russian thistle sample at a concentration of 0.20 μCi/g which was equal to control sample concentrations. In 1985, 1986, 1988, and 1989, no gamma-emitting

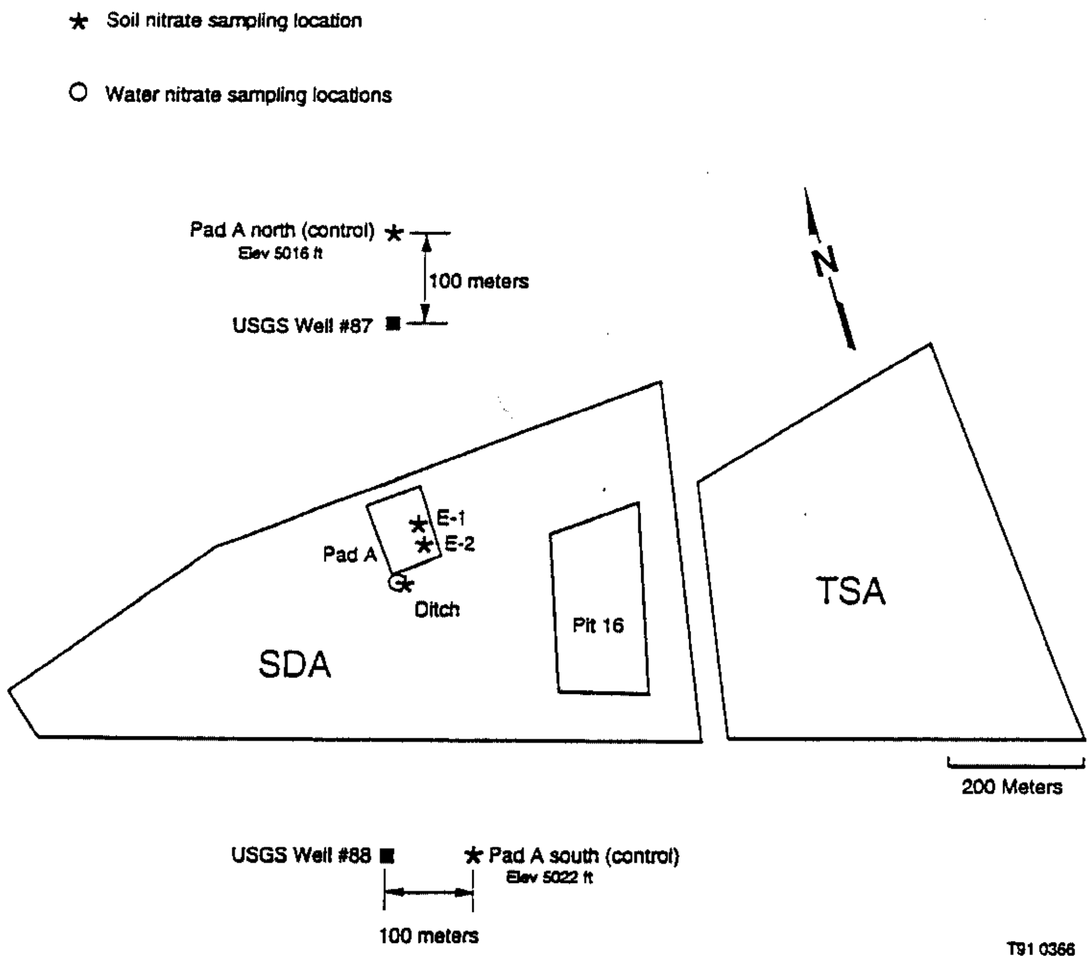


Figure 7. Pad A soil and water nitrate sampling locations.

Table 7. Nitrate concentrations in Pad A soils (1979 to 1984).

Location	Year	Spring	Average	Fall
		Results in parts per million		
Pad A Ditch	1979–1980 (4 samples)	NA[a]	23	NA
Soil Berm	1979–1980 (5 samples)	NA	7	NA
Spreading Areas	1979–1980 (2 samples)	NA	58	NA
Background Areas	1979–1980 (4 samples)	NA	6	NA
Pad A Ditch	1981	25.0	NA	30.0
East–1		12.6	NA	12.0
East–2		14.4	NA	11.0
North Control		7.3	NA	23.0
South Control		11.7	NA	9.2
Pad A Ditch	1982	35	NA	49
East–1		2.3	NA	11.7
East–2		3.7	NA	3.8
North Control		6.0	NA	17.6
South Control		2.3	NA	6.4
Pad A Ditch	1983	24	NA	28
East–1		5.5	NA	1
East–2		5.1	NA	1.4
North Control		14	NA	1.7
South Control		6.2	NA	1.6
Pad A Ditch	1984	1[b]	NA	42
Berm (Ave. E-1&2)	73	NA	12	
North Control		85	NA	4
South Control		35	NA	3

a. Not applicable. After 1981, both the spring and fall sample results were reported for each year. Thus, NA (not applicable) notations are used to distinguish where no data were available to complete the column. The average values for combined years are reported, because no additional data are available to distinguish sample results between 1979 and 1980.

b. Approximate detection limit is 1 ppm.

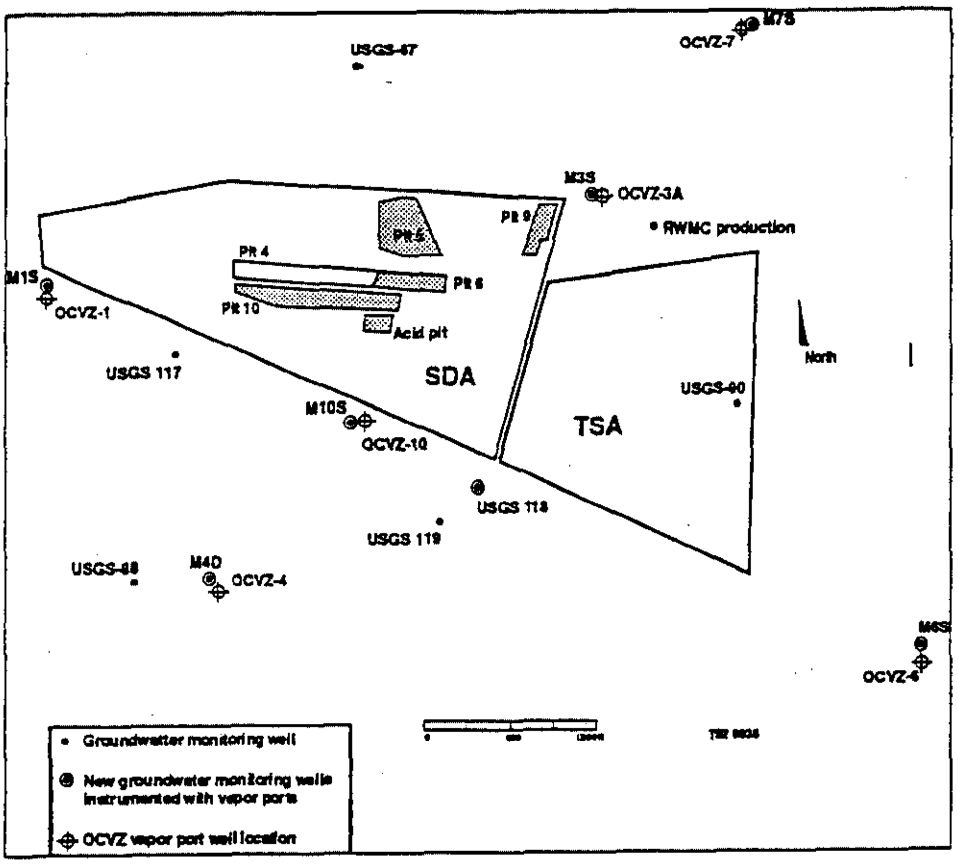


Figure 8. Well locations.

radionuclides were detected in vegetation collected at Pad A. No data were available for alpha or beta emitting analyses because of inconsistencies in Quality Assurance/Quality Control samples and results. In 1987, Cs-134 and -137 were detected in one sample at concentrations found in other RWMC samples of the same analysis.

5.2 Pad A Soil Overburden Sampling and Drum Retrieval Activities

1979 Inspection

The TSA/Transuranic Disposal Area (TDA) penetration project was initiated on September 26, 1979, and completed on October 12, 1979, when the excavated area was refilled with soil. The purpose of the penetration was to assess the condition of the oldest waste containers and to obtain soil samples from within the pad to detect migration or leakage of waste. The TDA was later renamed Pad A. The penetration locations are shown on Figure 9. Area B, which contains wooden boxes, and Area A, where 55-gal drums are stored, were selected for penetration and sample retrieval because they contained the oldest waste containers stored on the pad. The entire north end of the pad was established as the work area boundary.

Overburden removal began at the northeast corner of the pad to expose the oldest containers. Excavation continued south along the east boundary until ten rows of drums were uncovered and three rows of boxes were visible. The drums, lids, and lockrings showed varying degrees of corrosion, but appeared to be basically intact. One drum, which was breached during overburden removal, was resealed. The uncovered boxes appeared to be in an advanced state of deterioration caused by moisture accumulation and/or damage caused by excavation. The condition of the boxes and concern over safe handling of the drums precluded retrieval of waste containers.

The condition of the waste containers examined during penetration activities appeared to be questionable since the plywood boxes were in an advanced state of decomposition; however, the inner lining of the boxes appeared to be in good condition. The drums showed visible signs of rusting, especially on the tops and lockrings. Many of the drums showed damage such as dents and scratches, which probably occurred during disposal. Based on a visual inspection, none of the waste containers or their inner linings were breached to the extent that waste had been lost from the drums.

1988 Inspection

The strategy for the Pad A initial penetration investigation in December 1988 was to sample the Pad A cover soil, excavate to the waste, sample the interstitial soil between the drums, and inspect the condition of Pad A drums.

The soil sampling was proposed to determine the type, concentration, and location of metal and volatile organic contamination in the cover soils. The sampling was conducted near two locations on Pad A shown on Figure 10. The halogenated VOC analyses indicate that no VOCs were detected in the soils. The results of the analyses run on the eight inorganic samples collected during the cover soil sampling investigation are summarized in Table 8. The metal and salt compound analyses in Table 8 indicate that uranium was not

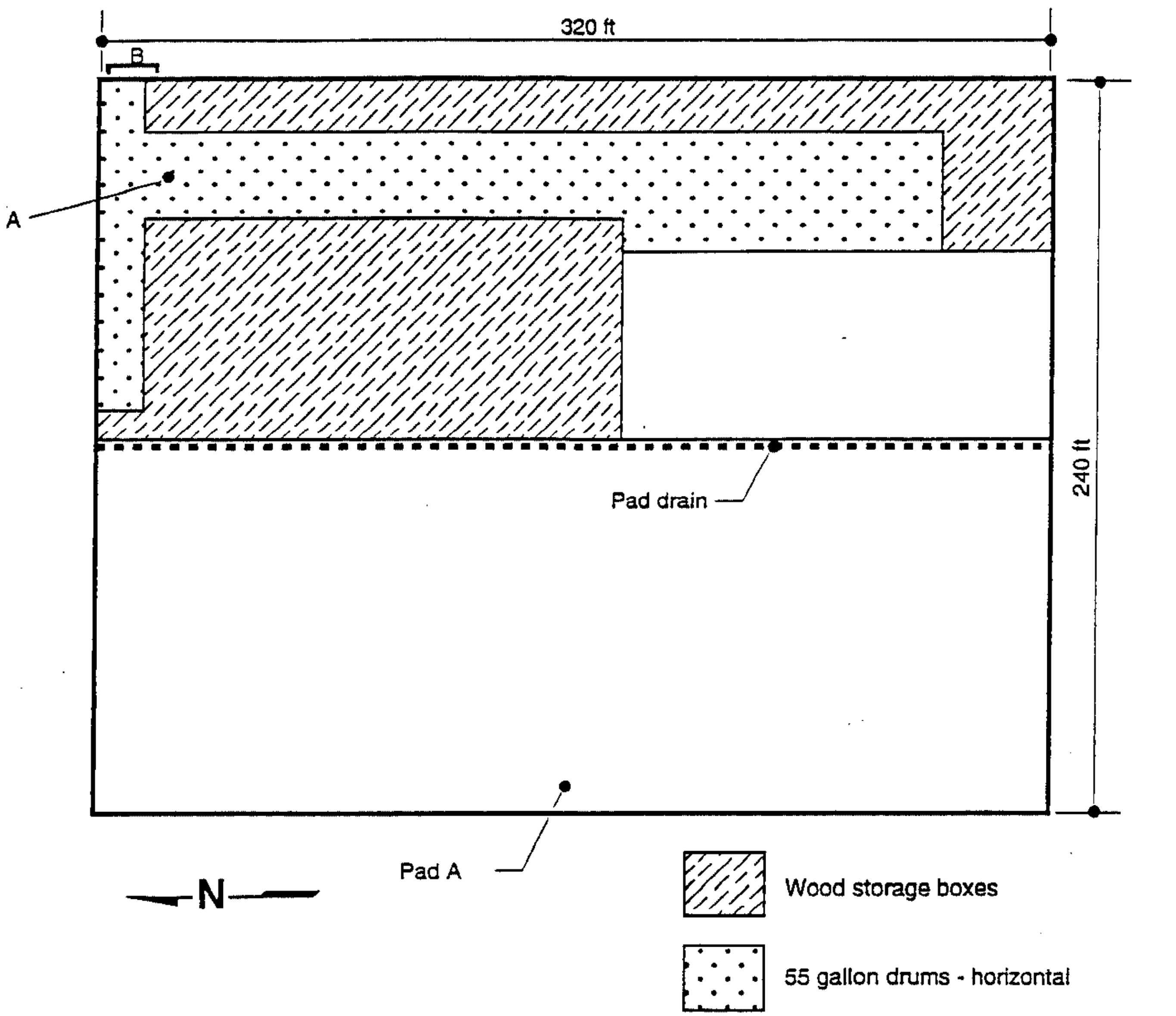


Figure 9. 1979 Pad A penetration locations (at points A and B).

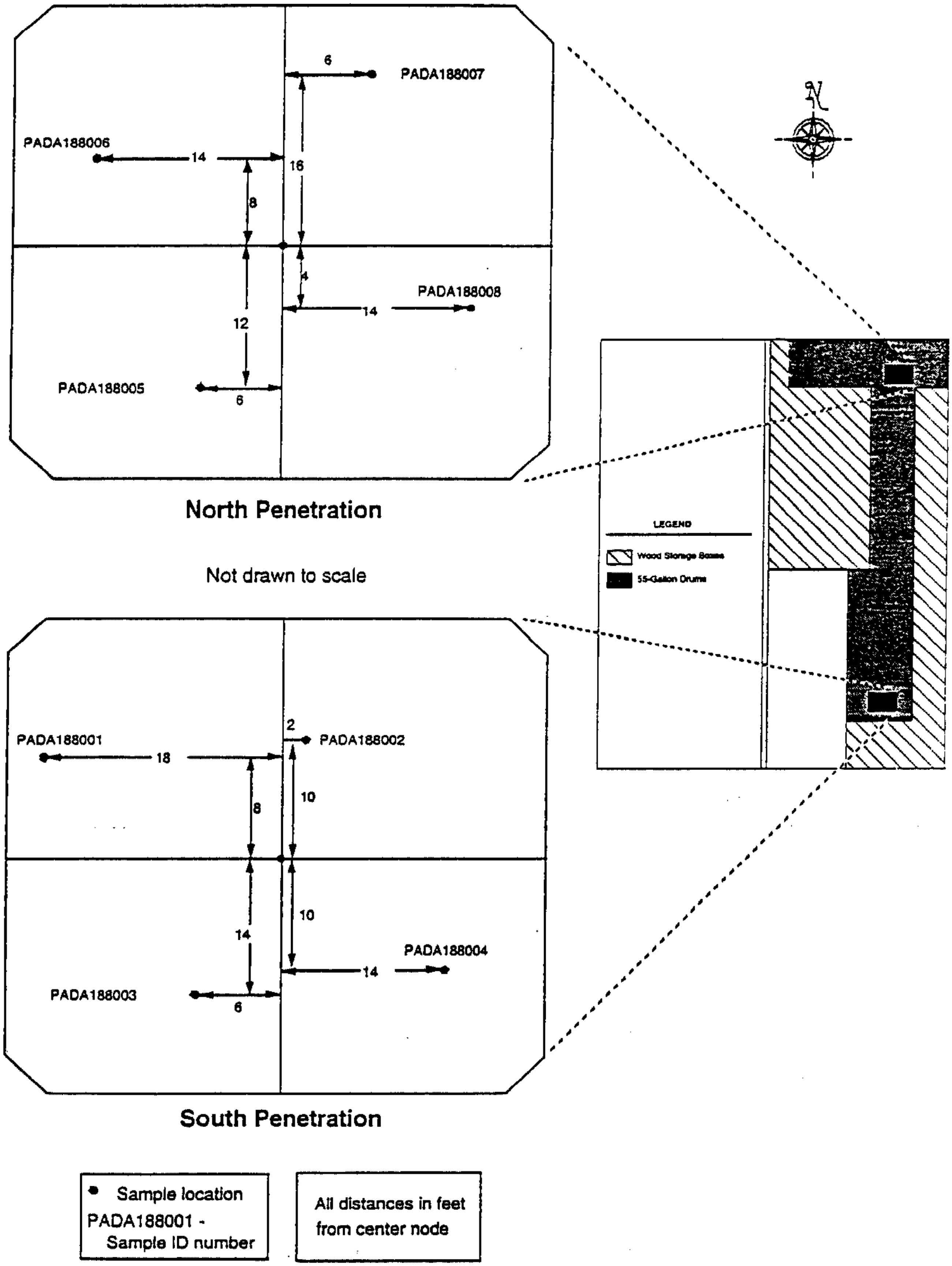


Figure 10. 1988 sampling locations for the Pad A initial penetration.

Table 8. Cover soils sample analysis for inorganics.[a]

Lab sample #	Matrix[b]	Beryllium	Uranium	Sodium	Potassium	Nitrate as NO_3
8808s041-001	Water	0.005	1.000	5.000	5.000	0.500
8808s041-003	Soil	1.100	200.000	1000.000	2249.000	5.700
8808s041-005	Soil	1.000	200.000	1081.000	2634.000	5.000
8808s041-006	Soil	1.180	200.000	1351.000	3347.000	5.300
8808s041-007	Soil	1.150	11.100	1001.000	3122.000	5.500
8808s041-008	Water	0.964	200.000	50.500	50.000	1.900
8808s041-009	Soil	1.340	200.000	1520.000	3418.000	0.500
8808s041-010	Soil	1.060	200.000	1213.000	2544.000	45.700
8808s041-011	Soil	1.300	200.000	1709.000	3508.000	0.500
8808s041-012	Soil	1.250	200.000	1206.000	3118.000	0.500

a. Source: Phase I sample analysis report.

b. Concentration units for water = µg/L; concentration units for soil = mg/kg.

detected in any samples; beryllium was detected in seven of the eight samples at low concentrations of up to 1.34 mg/kg; sodium was detected in all samples and ranged from 1000 to 1709 mg/kg; potassium was detected in all samples and ranged from 2249 to 3508 mg/kg; and nitrate was detected in five of the seven samples with values that ranged from 0.50 to 45.7 mg/kg. The background concentrations for beryllium, sodium, potassium, and nitrate are 1.5 mg/kg, 192 mg/kg, 5,180 mg/kg, and 36.5 mg/kg, respectively. Based on the results and low concentrations, it was concluded that the disturbance of Pad A overburden soils would not present a safety hazard to personnel.

Sampling and screening of the cover soils were conducted on November 1988 to determine the lateral extent of volatile organic contamination as shown in Figure 10. Nineteen samples were collected from designated points within the north and south penetration locations. The results of the screening analyses run on the 19 samples collected during the cover soil sample/screening investigation indicate that no VOCs were detected in the soils.

Efforts to demonstrate drum retrieval of Pad A containers began in October 1989. On December 7, 1989, eight drums were uncovered. All drums showed signs of corrosion; six were corroded through and contained openings ranging from the size of a pin hole to gaps 3 to 4 in. long. Drum surfaces in contact with plywood were also badly corroded. Because operational safety requirements prevented removal of breached drums, subsequent operations centered around two visually intact drums. However, on December 21, 1989, in situ ultrasonic testing and visual examination revealed a small hole in one of the drums. No holes were observed in the other drum which was subsequently removed from the penetration pit on January 8, 1990.

Results of radiological analysis did not indicate that radioactive contamination was present on or near the drums. Continuous air monitor (CAM) filters did not show detectable alpha contamination; beta-gamma airborne levels were less than airborne concentration limits. The VOC concentrations, measured with an organic field detection instrument, ranged from 0 to 10 ppm near the exposed drums. The VOCs in the space between the drums generally remained lower than 50 ppm but reached a high of 70 ppm.

6. SUMMARY OF SITE RISKS

The risk assessment for Pad A considered both human health and ecological risks. The human health risk assessment evaluated both present and future potential exposures to contaminants. The risk assessments were conducted in accordance with the EPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* and *Volume II: Environmental Assessment Manual* and other EPA guidance. The risk assessment methods and results are summarized in the following sections.

6.1 Human Health Risks

The risk assessment consisted of contaminant identification, exposure assessment, toxicity assessment, and human health risk characterization. The contaminants identified at Pad A were based on existing inventory records and process knowledge. The exposure assessment detailed the exposure pathways that exist at the site for workers, offsite residents, and potential future onsite residents. The toxicity assessment documented the adverse effects that may be caused in an individual as a result of exposure to a site contaminant.

The human health risk assessment evaluated current and future potential carcinogenic and noncarcinogenic risks associated with exposure to contaminants identified in the Pad A waste inventory. The human health evaluation used both the exposure concentrations and the toxicity data to determine a hazard index for potential noncarcinogenic effects and an excess cancer risk level for potential carcinogenic contaminants. In general, when a hazard index exceeds one, there may be a concern for potential noncarcinogenic health effects. The excess cancer risk level is the increase in the probability of contracting cancer. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) acceptable risk range is 1 in 10,000 to 1 in 1,000,000. An excess lifetime cancer risk of 1 in 10,000 (10^{-4}) indicates that an individual has up to a one chance in ten thousand of developing cancer over a lifetime of exposure to a site-related contaminant.

Key steps taken in the risk assessment process are summarized in Sections 6.1.1 through 6.1.5.

6.1.1 Identification of Contaminants of Concern

Contaminants evaluated in the baseline risk assessment (BRA) are the following radionuclides and inorganic compounds identified in the waste inventory, based on an evaluation of the RWMIS database:

Radionuclides	Inorganic Compounds
Potassium	Sodium Nitrate
Thorium	Potassium Nitrate
Uranium	Sodium Chloride
Plutonium	Potassium Chloride
Americium	Sodium Sulfate
	Potassium Sulfate
	Sodium Hydroxide
	Potassium Hydroxide
	Triuranium Octaoxide

Total estimated chemical masses and radionuclide activities are given in Tables 1 and 2 respectively.

Environmental monitoring of ground water, surface water, air, and soil has not demonstrated any contaminant releases attributable to Pad A wastes; therefore, fate and transport modeling of Pad A wastes was used in the BRA to evaluate potential risks. The modeling estimates contaminant movement through soil, air, and water. These estimates provide contaminant concentrations in a given medium at a specific time and allow evaluations of potential future risks to human and ecological receptors.

6.1.2 Exposure Assessment

<u>Exposed Populations</u>

Only exposure pathways deemed to be complete (i.e., where a plausible route of exposure can be demonstrated from the site to an individual) were quantitatively evaluated in the risk assessment. The populations at risk due to exposure from Pad A wastes were identified by considering both current and future use scenarios.

The human health risk assessment evaluated carcinogenic and noncarcinogenic risks for a period of 1,000 years after the waste was disposed (1972-2971). The 1,000-year period was further divided into three current and future use scenarios:

1. The current industrial scenario is expected to continue until the year 2015. Under this scenario, potential exposures to workers at the RWMC and residents adjacent to the INEL were evaluated.

2. Through the year 2090, it is assumed that DOE will continue to operate and maintain the RWMC to prevent unrestricted public access to the facility. (DOE Order 5820.2A, *Radioactive Waste Management*, requires control of radioactive waste disposal sites for a minimum of 100 years following closure.) Institutional controls would be implemented to control the facility and may include, but are not limited to, restricting land use; controlling public access; and the posting of signs, fencing, or other barriers. Under this scenario, potential exposures to workers at the RWMC and residents adjacent to the INEL were evaluated.

3. To determine the baseline risk in the absence of institutional controls, it is assumed that the INEL will be available for unrestricted use beyond the year 2090. The potential risks from residential development adjacent to the INEL, RWMC, and Pad A boundaries were evaluated.

Contaminant transport from the source to receptors was modeled using three different computer codes: (a) GWSCREEN, which models the transport of contaminants from the source to the subsurface; (b) DOSTOMAN, which models the transport of contaminants from the source to the surface; and (c) a simple "Box" model, which models transport of contaminants through the air, once they are brought to the surface.

The GWSCREEN is a combination of three different models. The models address the mass flux of contaminants released from the source, the transport of the contaminants through the unsaturated zone, and transport of the contaminants through the aquifer. In the source, the contaminant is assumed to be uniformly mixed throughout a parallelopiped source region and the mass flux from the source is assumed to be a first-order leach function.

For contaminant transport in the unsaturated zone, GWSCREEN employs a plug-flow model which incorporates retardation due to adsorption and decay of radionuclides but neglects dispersion. In this portion of GWSCREEN, the unsaturated zone is assumed to be homogeneous and the infiltration rate through the unsaturated zone is modeled as a steady-state one-dimensional flow.

The GWSCREEN uses a semianalytical solution to the advection-dispersion equation to model contaminant transport in the aquifer.

The DOSTOMAN code was used to model mechanical transport of contaminated soil through the uptake of waste through flora and burrowing mammals. The DOSTOMAN code mathematically simulates movement of contaminants from a subsurface "source" compartment to overlying "sink" compartments by means of solving a system of differential equations at specific time steps.

The movement of contaminants through air from Pad A to a distant receptor was modeled using a simple "Box" model solution. This method calculates the volume of air passing over Pad A that is swept out per second in order to determine a volumetric rate of contaminants from Pad A.

Several assumptions were used to model contaminant fate and transport. These assumptions, along with the associated uncertainties, are discussed in Section 6.1.5.

The fate and transport modeling indicated that radionuclides (with the exception of potassium-40) would not reach the aquifer within 1,000 years. The modeling showed potassium-40 reaching the aquifer within the 1,000 year timeframe, but it was not shown to pose an unacceptable risk.

The evaluation of current and future use scenarios assumes that industrial workers and residents would be located at the locations shown in Table 9. For the residential scenarios, it was assumed that a family would occupy the area and engage in agricultural activities such as irrigation of crops, livestock watering, and domestic activities that would utilize water pumped from the Snake River Plain Aquifer (SRPA).

Exposure Pathways

The following exposure pathways were evaluated in the risk assessment for both the current and future risk scenarios:

- Ingestion of surface soil
- Inhalation of contaminated dust
- Ingestion of drinking water (groundwater) from the SRPA
- Ingestion of food crops (residential scenario only)
- External exposure to radionuclides.

The exposure parameters (such as exposure frequency and duration), used in the risk assessment were obtained from Standard Default Exposure Factors guidance (EPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, "Standard Default Exposure Factors*, OSWER Directive 9285.6-03, 1991). The exposure parameters used are shown in Table 10.

Exposure Point Concentrations

Contaminant concentrations at points where the potential for human exposure is expected to occur are necessary to evaluate the intake of potentially exposed individuals. Exposure pathways from the source to individuals were evaluated using a groundwater transport computer model, GWSCREEN; a mechanical mixing model, DOSTOMAN; and an air transport model. The results of the computer modeling indicated nitrate concentrations in groundwater are estimated to peak approximately 250 years in the future at the predicted concentrations shown in Table 9. These concentrations, used in conjunction with future receptors being located at Pad A and RWMC boundaries, constitute a reasonable maximum exposure scenario at Pad A. Exposure point concentrations for the media associated with other pathways (e.g., ingestion of surface soil) are provided in Section 5 of the Pad A RI/FS Report.

Table 9. Summary of risks from Pad A. (Estimated risks are for releases from Pad A only. Cumulative risks for all sources at the RWMC will be evaluated in the RWMC Comprehensive RI/FS).

Scenario	Carcinogenic Risk[a]	Nitrates as Nitrogen in Groundwater (mg/L)[d]	Noncarcinogenic Risk[b] (Hazard Index)[c]
Current Scenario (through 2015)			
Pad A Boundary (industrial worker)	8 in 100,000,000 (8×10^{-8})	0	Less than 0.0001 (ingestion of soil)
RWMC Boundary (industrial worker)	4 in 1,000,000,000,000 (4×10^{-12})	0	Less than 0.0001 (ingestion of soil)
INEL Boundary (resident)	2 in 10,000,000,000,000 (2×10^{-13})	0	Less than 0.0001 (ingestion of food crops by child)
INEL Control Period (through year 2090)			
Pad A Boundary (industrial worker)	4 in 10,000,000 (4×10^{-7})	0	Less than 0.0001 (ingestion of soil)
RWMC Boundary (industrial worker)	4 in 10,000,000,000 (4×10^{-10})	0	Less than 0.0001 (ingestion of soil)
INEL Boundary (resident)	2 in 100,000,000,000 (2×10^{-11})	0	Less than 0.0001 (ingestion of food crops by child)
Post-Control Period (2090-2971)[e]			
Pad A Boundary (resident)	2 in 100,000 (2×10^{-5})	112[f]	6 (ingestion of water by infant)
RWMC Boundary (resident)	2 in 1,000,000 (2×10^{-6})	17[f]	1 (ingestion of water by infant)
INEL Boundary (resident)	4 in 10,000,000 (4×10^{-7})	3	0.2 (ingestion of water by infant)

a. The National Contingency Plan (NCP) defines an acceptable level of carcinogenic risk as less than 1 additional incidence of cancer in 10,000 to 1,000,000 individuals (10^{-4} to 10^{-6}).

b. A hazard index (the ratio of the level of exposure to an acceptable level) greater than 1 indicates that there may be concern for noncarcinogenic effects.

c. Unless otherwise specified, hazard index refers to total noncarcinogenic risks for all exposure pathways for an adult receptor. The text in parentheses indicates the primary contributing pathway.

d. The Federal drinking water standard for total nitrates (as nitrogen) in groundwater is 10 mg/L.

e. The concentrations and associated risks for this period correspond to the year 2246, at which time maximum nitrate concentrations occur in the groundwater.

f. The estimated concentrations were based on conservative groundwater modeling; actual concentrations are expected to be lower than the drinking water standard for nitrates.

Table 10. Exposure parameters used in the exposure assessment of contaminants at Pad A.

Exposure pathway	Exposure scenario	Intake rate[a]	Exposure frequency (days/yr)	Exposure duration (yr)	Body weight (kg)
Ingestion of soil	Industrial	50 mg/d	250	25	70
	Residential	200 mg/d (child, 0-6) 100 mg/d (adult)	350 350	6 24	15 70
Inhalation of contaminated dust	Industrial	20 m^3/d	250	25	70
	Residential	20 m^3/d	350	30	70
Ingestion of water	Industrial	1 L/d	250	25	70
	Residential	1.0 L/d (infant, 0-3)[b] 0.83 L/d (child, 3-6)[b] 2 L/d (adult)	350 350 350	3 3 24	12 17 70
Ingestion of food crops	Industrial	NA	NA	NA	NA
	Residential	4.18 g/d (child, 0-6)[b,c,d] 8.62 g/d (adult)[b,c]	350 350	6 24	15 70
External exposure to radionuclides	Industrial	NA	250	25	NA
	Residential	NA	350	30	NA

NA means that the parameter is not applicable to the exposure pathway or scenario.

a. EPA, 1991, *Risk Assessment Guidance for Superfund,* unless otherwise noted.

b. EPA, 1990, *Statement of Work RI/FS Risk Assessment Deliverables.*

c. Includes ingestion of fruits, vegetables, and root crops.

d. The child parameter for ingestion of food crops was adjusted from EPA (EPA, 1990, *Statement of Work RI/FS Risk Assessment Deliverables)* to estimate an average intake for children between ages 0 and 6.

Because of the overall conservative nature of the assumptions used in the fate and transport modeling, the actual nitrate concentrations in groundwater are expected to be lower than those predicted. In addition, the hazard indices calculated for infants and children are based on two additional conservative assumptions: (a) peak sodium nitrate and potassium nitrate concentrations occur in groundwater at the same time, and (b) infants and children are exposed to the sum of these peak concentrations. These latter two assumptions are conservative in that the groundwater analysis actually predicted different travel times to the groundwater for sodium nitrate and potassium nitrate (i.e., their predicted peak concentrations are not additive). Given these conservative elements, the hazard index associated with the groundwater ingestion exposure pathway is expected to be lower than 1.

6.1.3 Toxicity Assessment

The toxicity assessment addresses the potential for a contaminant to cause adverse effects in exposed populations and estimates the relationship between extent of exposure and extent of toxic injury (i.e., dose response relationship).

Two types of toxicity values were used in the risk assessment: reference doses, which are used to evaluate noncarcinogenic effects; and slope factors, which are used to evaluate carcinogenic effects. The Integrated Risk Information System database, an EPA online computer database, and the EPA Health Effects Assessment Summary Tables provided toxicity values for chemicals and slope factors for radionuclides for the contaminants at Pad A. Some of the toxicity values were derived based on available toxicity information. The reference doses used in the evaluation of noncarcinogenic effects are shown in Table 11. The inhalation pathway was not included in the risk calculations for noncarcinogenic effects because the inhalation reference doses were not available for the chemicals identified in the waste inventory of Pad A.

Slope factors used to evaluate carcinogenic effects for the radionuclides were obtained from an advance copy of the 1992 edition of the EPA *Health Effects Assessment Summary Tables: Annual Update,* FY 1992, ORR Publication 9200.6-303 (92-1) and are shown in Table 12. Pathway-specific slope factors were identified for ingestion, inhalation, and external exposure.

The primary contaminants of concern, based on the risk assessment, are the nitrate wastes. The primary concern with nitrate in the environment is related to its conversion by biological systems to nitrite. Nitrite acts in the blood to oxidize hemoglobin to methoglobin, which cannot transfer oxygen to the tissues. This condition is known as methemoglobinemia and is caused by high levels of nitrite or, indirectly, excessive levels of nitrate in humans. Nitrate toxicity can result from ingestion of water and vegetables high in nitrates (EPA 1992a). Infants are more susceptible to nitrate toxicity than adults. This increased susceptibility is attributed to high intake per unit weight, the presence of nitrate-reducing bacteria in the upper gastrointestinal tract, the condition of the mucosa, and the greater ease of oxidation of fetal hemoglobin. Infants (0-3) and small children (3-6) were evaluated as separate population subgroups when calculating risks from ingestion of nitrates. Other effects associated with ingestion of nitrates can include hypotension, tachycardia, respiratory depression, headache, nausea, vomiting, and diarrhea.

Table 11. Reference doses used to evaluate noncarcinogenic effects of contaminants at Pad A.

Contaminant	Ingestion RfD (mg/kg/day)
Nitrates (as nitrogen)	1.60E+00[a]
NaCl	8.60E+01[b]
KCl	9.50E+01[b]
Sulfates (Na_2SO4 and K_2SO4)	NA
NaOH	NA
KOH	NA
U_3O_8	9.00E-01[c]

NA not available (An established RfD is not available and no suitable toxicity information was available to derive a RfD).

a. The RfD for nitrates is based on nitrate-nitrogen; RfD obtained from IRIS (EPA, 1992, *Integrated Risk Assessment Information System*).

b. Provisional RfD estimated from recommended limit for daily intake; see text for explanation (Private communication with K. A. Poirier, Environmental Criteria and Assessment Office to C. Sweeney, EPA Region 10, January 24, 1992).

c. Provisional RfD estimated from a lowest-observed-adverse-effect-level (LOAEL) for dogs (Private communication with K. A. Poirier, Environmental Criteria and Assessment Office to C. Sweeney, EPA Region 10, January 24, 1992).

6.1.4 Risk Characterization

Risk characterization is the process of combining the results of the exposure and toxicity assessments. This process provides numerical quantification relative to the existence and magnitude of potential public health concerns related to the potential release of contaminants from the site.

Risk calculations are divided into carcinogenic and noncarcinogenic categories. The calculation of health risks from potential exposure to carcinogenic compounds involves the multiplication of cancer slope factors for each carcinogen and the estimated intake values for that contaminant.

Noncarcinogenic risk is assessed by comparison of the estimated daily intake of a contaminant to its applicable reference dose. A reference dose is a provisional estimate of the daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime. The estimated daily intake of each contaminant by an individual route of exposure is divided by its reference dose and the resulting quotients are added to provide a hazard index.

Table 12. Slope factors (SFs)[a] used to evaluate carcinogenic effects of radionuclides at Pad A.

Radionuclide	Ingestion SF $(pCi)^{-1}$	Inhalation SF $(pCi)^{-1}$	External exposure SF $[yr/(pCi/g)]^{-1}$
K-40	1.1E-11	7.6E-12	5.4E-07
Th-232	1.2E-11	2.8E-08	2.6E-11
U-234	1.6E-11	2.6E-08	3.0E-11
U-235	1.6E-11	2.5E-08	2.4E-07
U-238[b]	2.8E-11	5.2E-08	3.6E-08
Pu-238	2.2E-10	3.9E-08	2.8E-11
Pu-239	2.3E-10	3.8E-08	1.7E-11
Pu-240	2.3E-10	3.8E-08	2.7E-11
Pu-241	3.6E-12	2.3E-10	0.0E+00
Pu-242	2.2E-10	3.6E-08	2.3E-11
Am-241	2.4E-10	3.2E-08	4.9E-09

a. All SFs were obtained from EPA, 1992, *Health Effects Assessment Summary Tables (HEAST):* Annual Update, FY 1992.

b. The SFs for U-238 take into account the toxicity of its decay chain products (Th-234 and Pa-234).

Based on the results of the risk assessment, no current risk exists to workers or the public from Pad A. The only potential risk identified by the risk characterization of Pad A occurs at the Pad A boundary for residents during a 30-year period beginning in 2228, primarily due to ingestion of nitrate-contaminated groundwater. Noncarcinogenic and carcinogenic risks are summarized in Table 9.

Although not quantitatively evaluated in the risk assessment, prolonged exposure to Pad A contaminants through intrusion into the waste pile would likely pose an unacceptable risk to human health.

6.1.5 Uncertainty

Risk assessments are subject to uncertainty from inventory records, fate and transport estimation, exposure estimation, and toxicological data. Uncertainty was addressed by using health-protective assumptions that systematically overstate the magnitude of health risks. This process is intended to bound the plausible upper limits of risk and to facilitate an informed risk management decision. Table 13 is a summary of risk assessment assumptions and associated uncertainties.

6.2 Ecological Concerns

The ecological risk assessment qualitatively evaluated the potential ecological effects associated with the presence of Pad A. This ecological evaluation followed the EPA *Risk Assessment Guidance for Superfund Volume II.* The evaluation focused on the same contaminants and receptor locations as those evaluated in the human health assessment. Objectives of the ecological risk assessment are to qualitatively evaluate the potential risk to ecological receptors from the contaminants in Pad A. The assessment identified sensitive nonhuman species and characterized potential exposure pathways including ingestion of contaminated soil and vegetation by small mammals and contaminant uptake by plants.

The approach used in the ecological risk assessment is consistent with EPA guidance for evaluating risk. The steps included identification of contaminants, assessment of potential exposure pathways, and characterization of threats to exposed biota.

6.2.1 Exposure Assessment

The exposure scenarios assumed that the ecological species would be located at the same receptor locations identified in the human health evaluation, the Pad A boundary, the RWMC boundary, and the INEL boundary. The exposure pathways evaluated included intrusion of the waste after institutional control by plants (sagebrush) and small mammals (e.g., ground squirrels). Exposure routes included ingestion of contaminated soil and vegetation and prey by mammals and uptake of contaminants by plants.

6.2.2 Risk Characterization

The risk characterization involved evaluating the potential adverse effects on populations of organisms at Pad A. Impacts on environmental populations were assessed based on the exposure routes presented above. The evaluation covered peak concentrations for post-institutional control exposure periods. The quantitative evaluation that determines a toxic soil concentration compared to estimated concentration in the surface soil indicated that the Pad A contaminants will not pose a threat to the small burrowing animals.

Tolerance limits for plant species were evaluated and were not determined to be at levels that could adversely affect the plant species. These results of the ecological risk assessment indicate that Pad A wastes are not expected to have any significant disruptive effects on animal or plant populations or the local ecosystem. This information will be incorporated into a WAG-wide or INEL site-wide ecological risk assessment to determine the potential cumulative impacts to the environment from all areas.

Table 13. Pad A estimates of conservatism in the baseline risk assessment.

Estimate basis:

TYPE:		Conservative OR Not conservative
DEGREE:	**LOW**	(by factors of integers)
	MODERATE	(by factors of integers to one order of magnitude)
	HIGH	(by greater than one order of magnitude)

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Use of inventory data to identify and quantify potential contaminants	NOT CONSERVATIVE - LOW	
	- although Pad A disposal records have been verified against RFP records, uncertainties concerning measurement inaccuracies may exist in the information transmitted by RFP.	- None
	- chemical data was not provided in the original inventory data (retrieved drum sampling results indicate some hazardous chemical contaminants may be present)	- None
Biotic transport model (DOSTOMAN)	CONSERVATIVE - LOW TO MODERATE	
	- nitrate inventory was not depleted mathematically due to leaching (to account for source depletion) until 99% of mass was removed	- Results in higher estimated concentrations in soils/overburden and thus increased risk
	- deposition of contaminants was integrated over the maximum time allowed for each risk window	- Results in higher estimated concentrations in soils/overburden and thus increased risk (probably low bias)
	- mammal densities were combined for two different habitats (Russian thistle and Crested wheatgrass)	- Results in higher estimated concentrations in soils/overburden and thus increased risk (probably low bias)
	- vegetation and mammal densities were increased based on future addition of natural flora	- Increased densities for the future are based on data for vegetation and mammals in undisturbed sites (no known bias)
	- maximum animal burrowing depths were extrapolated beyond maximum INEL depths based on Hanford studies	- Results in significantly higher estimated concentrations in soils/overburden and thus increased risk (probably low bias)
	- all biomass of decayed plants and contaminants exhumed by mammals from the waste zone were retained in the upper 35 cm compartment of overburden	- Results in higher estimated concentrations in soils/overburden and thus increased risk (probably low bias) because wind erosion, leaching by water, and increased overburden thickness are not accounted for (moderate to high bias)

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Surface pathway model		
- Particulate matter	CONSERVATIVE - LOW - assumed 82 ug/m^3 for particulate resuspension (98% confidence level that the value will not be exceeded); assumed all particulate < 10 um and smaller	- Results in higher estimated soil concentrations for contaminants and higher estimated erosion rates
- Fallout calculations	CONSERVATIVE - LOW - constant fallout factor integrated over each risk window	- See above
- Erosion rates	NOT CONSERVATIVE - MODERATE to HIGH - standing water samples were used (does not take into account larger particles that would not be readily suspended in water, i.e., clay-sized particles); all runoff from Pad A is assumed to have collected in the sample location (ditch) which may not be a true indicator of runoff; no settling or flocculation was assumed to have occurred; no chemical weathering was considered; a recent evaluation of the overburden erosion was conducted by the EPA that indicated estimated sediment loss over the next 100 years may range 18 - 36 inches (see details in verbal discussion of Section 7.1.4.1)	- Results in lower estimated surface erosion rates
- Contaminant release rate box model assumptions	NOT CONSERVATIVE - MODERATE - 2m was used for erosion box model (vs. 20m) which results in lower soil removal rates (conservative for receptor exposure, but not conservative for surface erosion calculations)	- Results in lower estimated surface erosion rates

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Groundwater modeling		
- GWSCREEN code	CONSERVATIVE - MODERATE to HIGH	
	- assumes plug-flow (no dispersion) in the unsaturated zone	- GWSCREEN overestimates calculated peak concentrations and overestimates transport time to aquifer
	- infiltration rate assumed to be 5 cm/yr, actual is 0.8 to 1.1 cm/yr, and no credit was given for runoff	- overestimates transport time to aquifer and overestimates peak concentrations
- Dispersivity Values	NOT CONSERVATIVE - LOW	- underestimates calculated peak concentrations
	- dispersivity values were assumed to be 45 m and 20 m and are probably high estimates at the edge of Pad A	
- Fractured vs. homogeneous media	NOT CONSERVATIVE - LOW to MODERATE	- underestimates calculated peak concentrations and travel times
	- using GWSCREEN for fractured media may underestimate travel times due to greater potential for "short-circuiting" of fluids in the unsaturated zone, localized saturated zones, etc. Furthermore, poorly understood phenomena in the unsaturated zone, such as Taylor "instabilities" may further result in underestimation of travel times.	
- Use of estimated K_ds	CONSERVATIVE to NOT CONSERVATIVE	
	- K_ds in the source region (underlying soils) are assumed to be equal to K_ds in basalts at Hanford. The K_d of the soils is probably higher.	- Calculated peak concentrations are overestimated
	- unsaturated zone assumed homogeneous, i.e., no credit for surficial soils (1.5 to 10 feet thick below asphalt) or interbeds; K_ds in the source region are probably higher.	- Transport time to aquifer is underestimated
	- K_ds in the source and unsaturated zones are assumed to be equal to K_ds for crushed basalt at Hanford. The K_d of the unsaturated zone is probably lower.	- Calculated peak concentrations are underestimated
- Catastrophic failure of containers was assumed, boxes at time zero, barrels at 100 yrs	CONSERVATIVE - MODERATE	
	- Catastrophic failure assumes all material available for transport. In fact, plastic liners could retard migration for hundreds to thousands of years even when torn and partially decomposed.	- Results in overestimated peak concentrations

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Groundwater Modeling (Cont.)		
- Contaminants assumed uniformly distributed over source area	CONSERVATIVE - LOW to MODERATE	
· Radionuclides	· This assumption allows all water which enters source area to come in contact with contaminants. In fact, a significant volume of water entering contamination zone will not contact contaminants	- Peak contaminant concentrations are overestimated
· Nitrates	· This assumption allows all water which enters source area to come in contact with contaminants	- None
- Equivalent well screen thickness versus contaminant concentrations (re: Engineering Design File SEM-RWMC-91-002, R. R. Seitz)	- Contaminant is vertically mixed over the GWSCREEN equivalent well screen thickness, see specific cases below	
· Pad A Boundary (average residential well screen depth is assumed to be 12 m [40 ft] - a 25 m well screen depth was modeled in the BRA)	· NOT CONSERVATIVE - LOW	· If the contaminant plume remains in the upper 12 m of the aquifer, peak concentrations could be under-estimated by a factor of 2
· Pad A Boundary (average agricultural well screen depth is 46 m [150 ft] - a 25 m well screen depth was modeled in the BRA)	· CONSERVATIVE - LOW	· Peak concentrations could have been overestimated by a factor of 2
· WAG 7 Boundary (average residential well screen depth is 12 m - 65 m was modeled)	· NOT CONSERVATIVE - LOW	· If the contaminant plume remains in the upper 12 m of the aquifer, peak concentrations could be under-estimated by a factor of 5
· WAG 7 Boundary (average agricultural well screen depth is 46 m - 65 m was modeled)	· NOT CONSERVATIVE - LOW	· If the contaminant plume remains in the upper 46 m of the aquifer, peak concentrations could be under-estimated by a factor of 1.4
· INEL Boundary (average residential well screen depth is 12 m - 76 m was modeled)	· NOT CONSERVATIVE - LOW	· If the contaminant plume remains in the upper 12 m of the aquifer, peak concentrations could be under-estimated by a factor of 6
· INEL Boundary (average agricultural well screen depth is 46 m - 76 m was modeled)	· NOT CONSERVATIVE - LOW	· If the contaminant plume remains in the upper 46 m of the aquifer, peak concentrations could be under-estimated by a factor of 1.7
- Radionuclide hydroxide formation and effects on mobility	· NOT CONSERVATIVE - LOW - Am and Pu may exist in the form of hydroxides in the nitrate salts. The effects on the mobility of these hydroxide forms (specific to Pad A contaminants) are unknown.	- Peak contaminant concentrations for Am and Pu may or may not be underestimated

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Food crops evaluation - Use of B_v values	CONSERVATIVE - LOW - for children, peak concentrations used instead of 25- or 30-year averages (due to the exposure duration being so short)	- Results in higher HQ values for infants/children
Exposure parameters - EPA values	CONSERVATIVE - MODERATE - EPA exposure values are conservative by default and Pad A exposure values used are EPA recommended values	- Results in higher exposure values for all receptors
Land use scenarios - Occupational scenarios	CONSERVATIVE - LOW - due to conservatism contained in the EPA default parameters	- Results in higher exposure values for institutional scenario
- Future scenarios (i.e., residential well at edge of OU, WAG, and INEL boundaries	CONSERVATIVE - LOW - all relevant contaminants determined to reach the aquifer are present during the same time period	- Same as above
- Intrusion scenarios	NOT CONSERVATIVE - MODERATE TO HIGH - intrusion scenarios only qualitatively discussed and it is stipulated that any prolonged exposure to Pad A contaminants will present a risk to human health	- An intrusion scenario may or may not result in increased risk above that calculated for the assumed scenario, depending upon the intrusion scenario (i.e., time of exposure to contaminants, etc.)
Lack of toxicity values for some chemicals	NOT CONSERVATIVE - LOW - qualitative analysis was performed for substances lacking EPA toxicity values using occupational limits/standards and the media concentrations for these contaminants are very low (with no expected health hazards as a result)	- None
Toxicity assessment - EPA values	CONSERVATIVE - MODERATE - high-dose to low-dose extrapolation of adverse effects, extrapolation from animal studies, short-term to long-term exposure, and difference in population sensitivities	- Results in higher toxicity values for receptors
Assumption of dose additivity - No synergism or antagonism	NOT CONSERVATIVE - LOW TO MODERATE - may underestimate or overestimate risks; EPA suggests risks are to be treated as additive since necessary data to assess these interactions are rarely available	- None

Uncertainty	Estimate of Type & Degree	Effect of Conservatism on BRA Results
Actual probability of receptor locations	For all receptor locations and scenarios, the risks depend on the likelihood of access to the contaminants and the period of exposure.	
- Pad A boundary for infant/child/adult	CONSERVATIVE - MODERATE	
	- the probability of a residence being established in this portion of the INEL is extremely low based on current demographic trends and existing knowledge of the site	- Results in higher exposure values for residential receptors since groundwater wells are located in maximum plume concentrations
	- Assumes that the resident living at the edge of the boundary has an infant or child at the same time the peak nitrate concentration occurs in the groundwater	- Results in higher exposure values for residential receptors since groundwater wells are located in maximum plume concentrations
- WAG 7 boundary for infant/child/adult	CONSERVATIVE - LOW	
	- See previous item	- Same as above
- INEL boundary for infant/child/adult	CONSERVATIVE - LOW	
	- See previous item	- Same as above
Institutional control issues		
- Likelihood of INEL becoming National Park/Reservation	NOT CONSERVATIVE - LOW	
	- institutional control will be maintained under existing regulations and orders and the length of time of control may be extended	- None
- INEL available for use prior to 100 yr institutional control period	NOT CONSERVATIVE - LOW	
	- no public use of INEL is assumed during the institutional control period based on existing DOE orders and other regulations.	- None

6.3 Basis for Response

Threatened releases of, and prolonged direct contact with, hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present a potential threat to public health, welfare, or the environment at the boundary of Pad A.

7. DESCRIPTION OF ALTERNATIVES

7.1 Remedial Action Objectives

The risk assessment indicates that there is no current risk to workers or the public from Pad A. However, fate and transport modeling indicated a potential future risk in approximately 250 years due to exceedances of drinking water standards for nitrate if residents used the groundwater directly adjacent to the Pad A boundary. This fate and transport modeling used conservative assumptions in order not to underestimate risks. Actual nitrate concentrations in groundwater are not expected to exceed drinking water standards at the WAG 7 boundary and, therefore, Pad A is not expected to pose an unacceptable risk to human health or the environment now or in the future.

The results of investigation and risk assessment indicate that the existing Pad A cover is a protective barrier for the Pad A contents; however, although not quantitatively evaluated, prolonged direct contact with Pad A waste would likely pose an unacceptable risk. Consequently, the focus of the remedial action objectives and the alternative development was on maintaining the effectiveness of the existing cover to prevent direct exposure to the wastes and to minimize the potential for contaminant migration from the pad to surface water or groundwater. The alternatives developed were also designed to address the uncertainty associated with the fate and transport modeling and with future land use assumptions by including environmental monitoring and institutional controls to restrict access.

Remedial action objectives also include the identification of preliminary remediation goals that are established based on both risk and on frequently used standards or ARARs. The nitrates at Pad A have been reviewed against 40 CFR 261.21(a)(4) and 49 CFR 173.151 and appear to exhibit the properties of an oxidizer. It is recognized that this type of oxidizer can have the characteristic of ignitability. The RCRA closure requirements are applicable when (a) the waste is hazardous and (b) the unit received the waste after RCRA requirements became effective. Pad A does contain RCRA hazardous waste but the waste was placed from 1972 through 1978, before RCRA requirements became effective; therefore, RCRA closure requirements are not applicable to the wastes in Pad A. However, certain RCRA closure requirements in 40 CFR Subpart N, specifically §264.310, are considered to be relevant and appropriate. Because the residual contamination in the pad may pose a direct contact threat, but is not expected to pose a groundwater threat, relevant and appropriate requirements include: (a) a cover, which may be permeable, to address the direct contact threat; (b) limited long-term management including site and cover maintenance and groundwater monitoring; and (c) institutional controls (e.g., land-use restrictions or deed notices) to restrict access.

The remedial action objectives would be achieved by implementing the general response actions described below. Alternatives were subsequently developed based on these general response actions.

- Containment with a cover that:
  - Provides long-term minimization or migration of liquids through the pad (e.g., with an infiltration rate of less than 5 cm/yr);
  - Functions with minimum maintenance;
  - Promotes drainage and minimizes erosion or abrasion of the cover;
  - Accommodates settling and subsidence such that the cover integrity is maintained; and
  - Has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

- Maintenance of the cover integrity and effectiveness including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, and other events and to prevent run-on and run-off from eroding or otherwise damaging the cover.

- Environmental monitoring of air, groundwater, and surface water/sediments to provide early detection of a potential release to subsurface, groundwater, or surface pathways.

- Institutional controls such as access and land use restrictions to prevent intrusion into the wastes. The restrictions would prevent activities occurring that allow direct exposure to contaminants in Pad A wastes.

7.2 Summary of Alternatives

In accordance with Section 121 of CERCLA, the Feasibility Study identified alternatives that (a) achieve the stated remedial action objectives, (b) provide overall protection of human health and the environment, (c) meet ARARs, and (d) are cost-effective.

The alternatives evaluated in the FS for Pad A were Alternative 1 - Containment, Alternative 2 - Limited Action, and Alternative 3 - No Action. Descriptions of each alternative are provided in the following sections.

Each of the alternatives evaluated considers leaving the wastes in place and involves utilization of a cover or cap to continue to effectively isolate the wastes. Other alternatives such as excavation, treatment, and disposal were not evaluated because the results of the investigation and the risk assessment indicated that the Pad A wastes would not pose an unacceptable risk if left in place assuming prolonged direct contact with the waste is prevented. Consequently, the impacts/effects for each of the alternatives are similar, as are the regulatory requirements. Therefore, the ARARs for each of the alternatives are the same. Refer to Table 14 for a summary of ARARs and to-be-considered (TBC) criteria for the alternatives.

7.3 Alternative 1 - Containment of Pad A Materials

Two subalternatives were developed and evaluated in the detailed analysis. One subalternative involves construction of a composite earthen material cover to be placed directly over the existing Pad A cover. Several combinations of different earthen material types were evaluated within this alternative using layers of clay, soil, rock and/or sand. A cross-sectional view of several containment options under this subalternative is represented in Figure 11. It is estimated that a composite earthen cover would require 10 to 15 workers approximately 60 weeks to complete construction. Construction and 30 years of monitoring costs are estimated to range from $1.8 million to $2.3 million.

The other subalternative evaluated would involve construction of an earthen/synthetic material cover over the existing waste pile using clay, gravel, and a plastic flexible membrane liner. It is estimated that an earthen/synthetic cover would require 10 to 15 workers 60 weeks to complete construction. Construction and 30 years of monitoring costs are estimated at $2.4 million.

Table 14. Summary of ARARs and TBC criteria for Pad A alternatives.

Statute	Regulation	Alternative 1 Containment	Alternative 2 Limited Action
HWMA	Closure and Post-Closure Care - Landfill Closure IDAPA §16.01.05008 (40 CFR 264.310)	R	R
IDAPA	IDAPA §16.01.01.01251 and §16.01.01252 (Rules for Control of Fugitive Dust)	A	A
	RCRA ARARs: Focus on Closure Requirements, OSWER 9234.2-04FS, October 1989.	TBC	TBC
	Evaluating Cover Systems for Solid and Hazardous Waste (Revised), OSWER 9476.00-1, September 1982.	TBC	TBC
	DOE 5820.2A, Radioactive Waste Management	TBC	TBC
	DOE 5400.5, Radiation Protection of the Public and the Environment	TBC	TBC

A = Applicable
R = Relevant and Appropriate
TBC = To-Be-Considered

Both of the subalternatives would be capable of being placed directly over the existing Pad A wastes and soil cover. This alternative ensures that the entire volume of Pad A wastes (13,341 yd^3) that remains in place is effectively isolated with an impermeable cover of composite design. These subalternatives provide continuing isolation of the Pad A wastes from the environment at the surface and protection of human health and the environment. These subalternatives ensure continued protection by preventing contaminant migration to groundwater and reducing the accessibility of waste materials at the surface of the cover.

Certain RCRA closure requirements in 40 CFR 264 Subpart N are considered to be relevant and appropriate with respect to the waste materials remaining on Pad A. Under this alternative, Pad A would be closed and managed in accordance with the substantive relevant and appropriate requirements of 40 CFR §264.310 - Closure and post-closure care.

Institutional controls (i.e., access/land use restrictions) would be continued under this alternative to maintain protection of human health and the environment. The controls would restrict activities occurring onsite that allow direct exposure to contaminants in Pad A.

Because this alternative leaves wastes in place, long-term monitoring (for groundwater, soil, surface water, and air) would be conducted to provide early detection of a potential release to the subsurface, groundwater, or surface pathways. Additionally, infiltration rates will be monitored to ensure the effectiveness of the cover.

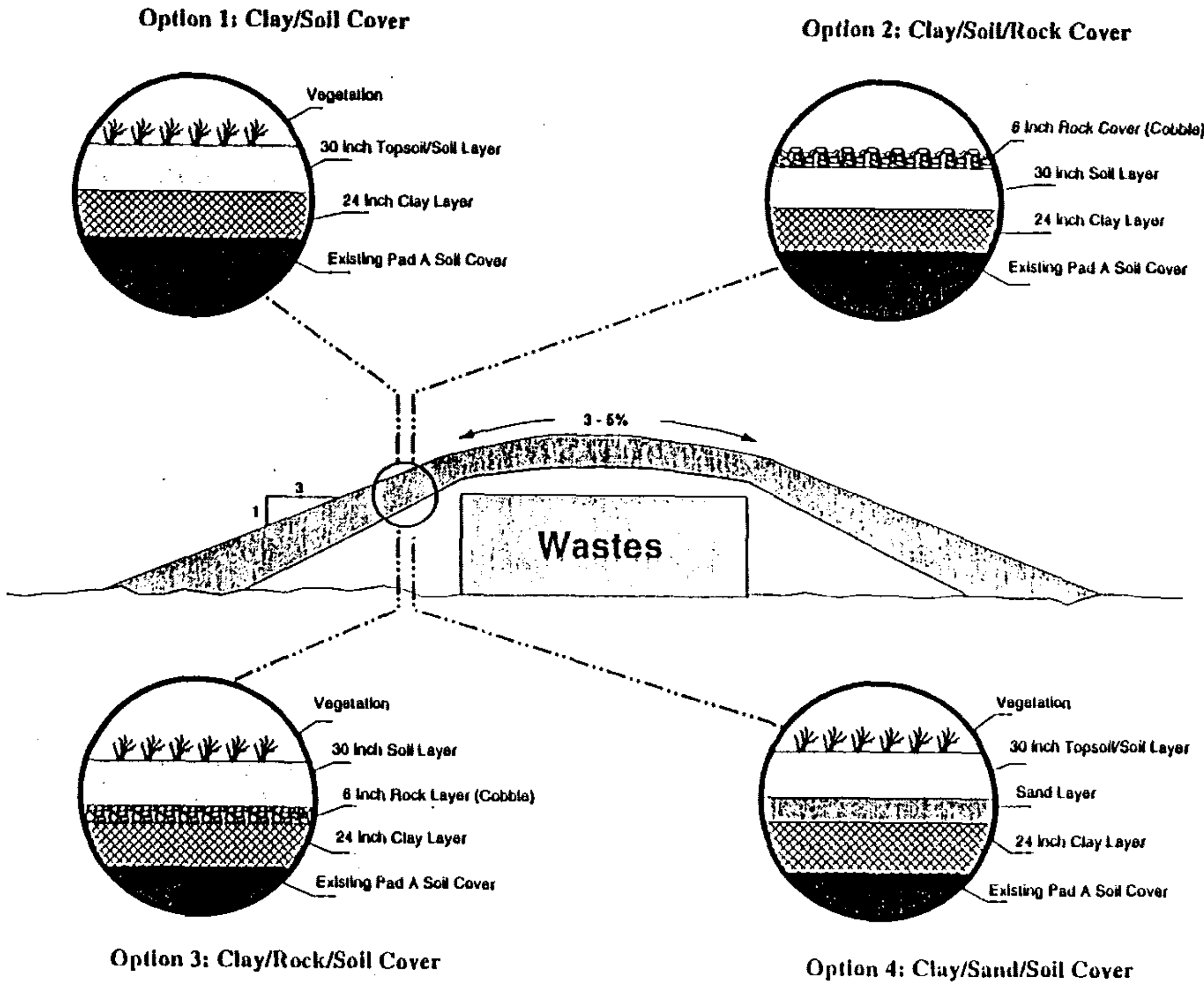


Figure 11. Cross-sections of composite earthen material cover options.

7.4 Alternative 2 - Limited Action

Under Alternative 2, actions would focus on recontouring, subsidence correction, and continued maintenance of the existing soil cover. This alternative is intended to contain the Pad A waste materials, to prevent exposure of these materials through erosion by wind or water, and to limit the infiltration of rainwater through the waste. The overall cost for upgrading the existing soil cover, continued maintenance, and 30 years of monitoring is estimated at $1.7 million.

This alternative ensures that the entire volume of Pad A wastes (13,341 yd^3) that remains in place is effectively isolated with a protective soil cover. This alternative provides continuing isolation of the Pad A wastes from the environment at the surface and protection of human health and the environment. The placement of additional soil material for contouring and maintenance of this soil cover will provide continuing isolation of the waste, thus minimizing the potential for direct exposure of the waste to the environment via erosion and/or biotic transport. Alternative 2 ensures continued protection by preventing contaminant migration to groundwater and reducing the accessibility of waste materials at the surface of the cover.

Certain RCRA closure requirements in 40 CFR 264 Subpart N are considered to be relevant and appropriate with respect to the waste materials remaining on Pad A. Under this alternative, Pad A would be closed and managed in accordance with the relevant and appropriate requirements of 40 CFR §264.310 - Closure and post-closure care.

Institutional controls (i.e., access/land use restrictions) would be continued under this alternative to aid in protecting human health and the environment. The controls would restrict activities occurring onsite that allow direct exposure to contaminants in Pad A.

Because this alternative also leaves wastes in place, and long-term monitoring (for groundwater, soil, surface water, and air) would be required to provide early detection of a potential release to the subsurface, groundwater, or surface pathways. Additionally, infiltration rates will be monitored to ensure effectiveness of the existing cover.

7.5 Alternative 3 - No Action

Under this alternative, no action other than groundwater, surface water, air, and soil monitoring would be implemented. All wastes currently in place on Pad A are assumed to remain on the pad with no corrective action or maintenance implemented for the existing soil cover. This alternative was a "baseline" case against which the other alternatives were compared and does not include the use of institutional controls to prevent uncontrolled access to the site nor does it address the uncertainties associated with the BRA.

Long-term monitoring (for groundwater, soil, surface water, and air) would be also be conducted for this alternative to provide early detection of a potential release to the subsurface, groundwater, or surface pathways. Monitoring costs for the next 30 years are estimated at $692,000.

8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

CERCLA guidance requires that each remedial alternative be compared according to nine criteria. Those criteria are subdivided into three categories: (a) threshold criteria that relate directly to statutory findings and must be satisfied by each chosen alternative; (b) primary balancing criteria that include long- and short-term effectiveness, implementability, reduction of toxicity, mobility, and volume, and cost; and (c) modifying criteria that measure the acceptability of the alternatives to State agencies and the community. The following sections summarize the evaluation of the candidate remedial alternatives according to these criteria.

8.1 Threshold Criteria

The remedial alternatives were evaluated in relation to the threshold criteria: overall protection of human health and the environment and compliance with ARARs. The threshold criteria must be met by the remedial alternatives for further consideration as potential remedies for the ROD.

8.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Each of the remedial action alternatives satisfies the criterion of overall protection of human health and the environment. The alternatives provide protection by minimizing the risk of potential contaminant migration to the groundwater and by maintaining the inaccessibility of the Pad A waste materials, thereby preventing direct exposure to the wastes.

8.1.2 Compliance with ARARs

CERCLA, as amended by the SARA, requires that remedial actions for Superfund sites comply with federal and state laws that are applicable to the action being taken. Remedial actions must also comply with the requirements of laws and regulations that are not directly applicable but are relevant and appropriate, in other words, requirements that pertain to situations sufficiently similar to those encountered at a Superfund site so that their use is well suited to the site. Combined, these are referred to as ARARs. State ARARs are limited to those requirements that are (a) promulgated, (b) uniformly applied, and (c) and are more stringent than federal requirements. Compliance with ARARs requires evaluation of the remedial alternatives for compliance with chemical, location, and action-specific ARARs or justification for a waiver.

ARARs are identified for each alternative considered at the Pad A unit under the Description of Alternatives (Table 14 in Section 7). All alternatives would be designed to meet the identified ARARs for this unit, with the exception that the No Action alternative does not include institutional controls.

8.2 Balancing Criteria

Once an alternative satisfies the threshold criteria, five balancing criteria are used to evaluate other aspects of the potential remedial alternatives. Each alternative is evaluated using each of the balancing criteria. The balance criteria are used in refining the selection of the candidate alternatives for the site. The five balancing criteria are: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. Each criterion is further explained in the following sections. Table 15 includes a summary of the comparative analysis (relative ranking) of the alternatives.

8.2.1 Long-term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after remedial action objectives have been met.

Alternatives 1 and 2 provide long-term effectiveness and permanence because the existing cover and composite earthen material and earthen/synthetic material cover options provide for reliable isolation of the Pad A when combined with institutional controls. A degree of residual risk would remain, however, as the waste material would not be removed from Pad A.

The No Action alternative would likely provide a lower level of long-term effectiveness and permanence because of the lack of cover maintenance and the potential for future uncontrolled erosion and subsidence.

Table 15. Evaluation of alternatives

Criteria	Alternative 1 Containment	Alternative 2 Limited Action
Long-term effectiveness	BEST	BEST
Reduction of toxicity, mobility, or volume through treatment	N/A[a]	N/A[a]
Short-term effectiveness	GOOD	GOOD
Implementability	GOOD	BEST
Cost	GOOD	BEST

a. No treatment alternatives were evaluated

8.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies, which permanently reduce toxicity, mobility, or volume of the hazardous substances as their principal element.

The Pad A investigations and risk assessment indicated that maintenance of the existing cover would reliably control Pad A wastes in place; therefore, no treatment alternatives were evaluated.

8.2.3 Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to achieve protection and reduce any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

In general, alternatives requiring the least amount of worker interface (i.e., construction and/or operations) and Pad A waste handling rank the highest in terms of short-term effectiveness.

Alternatives 1 and 2 rank equally under this criterion since they do not require handling of the Pad A wastes. No increase in potential risk to the public would occur because the Pad A waste will not be disturbed under either of these alternatives. Alternative 1 may require more time to complete than Alternative 2 based on the complexity of the design of the containment cover.

8.2.4 Implementability

The implementability criterion has the following three factors requiring evaluation: (a) technical feasibility, (b) administrative feasibility, and (c) the availability of services and materials. Technical feasibility requires an evaluation of the ability to construct and operate the technology, the reliability of the technology, the ease of undertaking additional remedial action (if necessary), and monitoring considerations. The ability to coordinate actions with other agencies is one factor for evaluating administrative feasibility, and the agencies have demonstrated this throughout the project to date. Other administrative activities that would be readily implementable include planning, use of administrative controls, and personnel training. In terms of services and materials, an evaluation of the following availability factors is required: necessary equipment and specialists, prospective technologies, and cover materials.

Each of the alternatives retained for detailed analysis is readily implementable. However, Alternative 1 ranks slightly lower than Alternative 2 and the No Action alternative because of the increased difficulty of installing and maintaining the multi-layered cover systems.

8.2.5 Cost

In evaluating project costs, an estimation of capital costs, operation and maintenance costs, and present worth costs is required. In accordance with the RI/FS guidance, the costs presented are estimates (i.e., -30% to +50%). Actual costs could vary based on the final design and detailed cost itemization. The cost estimates for these alternatives are listed in Table 16.

8.3 Modifying Criteria

The modifying criteria are used in the final evaluation of remedial alternatives. The two modifying criteria are state and community acceptance. For both of these criteria, the factors that are considered include the elements of the alternatives that are supported, the elements of the alternatives that are not supported, and the elements of the alternatives that have strong opposition.

8.3.1 State Acceptance

The IDHW concurs with the selected remedial alternative, Limited Action. The IDHW has been involved in the development and review of the RI/FS report, the Proposed Plan, this ROD, and other project activities such as public meetings. Comments received from IDHW were incorporated into these documents, which have been issued with IDHW concurrence.

Table 16. Pad A alternative cost estimates (in present dollar value)

Cost Elements	Alternative 1 - Containment[a]	Alternative 2 - Limited Action	Alternative 3 - No Action
Construction & Construction Operations	$753,689	$435,105	0
Post-Closure Maintenance & 30 years Monitoring[b]	$707,133	$707,133	$691,760
Indirects	$831,678	$547,381	$155,646
Contingency	$687,750	$506,886	$254,222
TOTAL	$2,980,250	$2,196,506	$1,101,628

a. Represents average cost of the five options considered under Alternative 1.
b. Net present value calculated using a 5% discount value.

8.3.2 Community Acceptance

This assessment evaluates the general community response to the proposed alternatives presented in the Proposed Plan. Specific comments are responded to in the Responsiveness Summary portion of this document.

Eleven individuals provided written comments on the Pad A Proposed Plan during the public comment period. One written comment was received after the comment period ended. Nine individuals also provided oral comments at the public meetings held in Idaho Falls, Boise, and Moscow. Public opinion on the preferred alternative, in no particular order, included (a) Alternative #1 should have been selected, (b) Limited Action was the best alternative presented, (c) cumulative, INEL-wide risks should have been evaluated, (d) catastrophic future events were not addressed adequately, (e) long-term control of the site cannot be guaranteed, (f) control of public meetings needs to be improved, and (g) treatment and removal of the Pad A wastes from the site should have been evaluated and selected. Additional comments were provided requesting additional technical information, or concerns about the integrity of containers and the current Pad A site. In general, public opinion was split between those in favor of the preferred alternative, those in opposition, and individuals requesting additional, or clarifying information.

9. SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of alternatives, and public comments, DOE-ID, EPA, and IDHW have selected Alternative 2 - Limited Action as the most appropriate remedy for Pad A, OU 7-12 at the RWMC. The BRA indicates that there is no current risk to workers or the public from Pad A. The fate and transport modeling indicated a potential future risk in approximately 250 years due to exceedances of drinking water standards for nitrate if residents used the groundwater directly adjacent to the Pad A boundary; however, this fate and transport modeling used conservative assumptions in order not to underestimate risks. Actual nitrate concentrations in groundwater are not expected to exceed drinking water standards at the WAG 7 boundary; therefore, Pad A is not expected to pose an unacceptable risk to human health or the environment in the future. Although not quantitatively evaluated, prolonged direct contact with the Pad A wastes would likely pose an unacceptable risk. Alternative 2 - Limited Action was therefore selected to address uncertainties associated with the fate and transport modeling and future land use around the RWMC, in order to maintain existing conditions and continue to restrict access to Pad A in order to prevent direct contact with the wastes.

9.1 Limited Action Description

The major components of Alternative 2 - Limited Action include recontouring and slope correction, institutional controls, and maintenance and monitoring of the existing cover at Pad A. The selected alternative is believed to provide the best balance of trade-offs among the alternatives with respect to the nine CERCLA evaluation criteria. DOE-ID, EPA, and IDHW believe the preferred alternative is protective of human health and the environment, complies with applicable federal and state regulations, and is cost-effective.

Maintenance will include subsidence and erosion control of the Pad A cover. Monitoring will continue to be conducted at Pad A to ensure the effectiveness of the existing cover. Groundwater, air, surface water, and soil monitoring will be designed and conducted to provide early detection of a potential release to the subsurface, groundwater, or surface pathways and ensure continued effectiveness of the soil cover.

Institutional controls (i.e., access/land use restrictions, controlling public access, posting signs, and erecting/maintaining barriers or fences) would be continued under this alternative to aid in protecting human health and the environment. The restrictions would reduce the likelihood of activities occurring onsite that allow direct exposure to contaminants in Pad A.

Because this remedy will result in wastes remaining onsite, maintenance and monitoring of Pad A will continue. Independent reviews of the maintenance and monitoring data will be conducted by EPA and IDHW. This evaluation will be conducted within two years of ROD signature, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

9.2 Remediation Goals

The purpose of this response action is to continue to prevent exposure to the wastes disposed at Pad A. This will be accomplished by maintaining the existing cover and continuing to restrict access to Pad A in order to prevent direct contact with the wastes.

Performance standards will be implemented to ensure that the cover continues to provide protection against direct exposure to Pad A wastes. The performance standards identified for Limited Action include (a) maintaining the soil cover to prevent excessive infiltration thereby providing continued protection of groundwater, and (b) ensuring erosion is monitored and controlled to limit soil loss such that the infiltration rates are not affected and the potential for exposing wastes is eliminated. The inspection and maintenance of the soil cover will be conducted concurrent with the monitoring program. Implementation of the maintenance and monitoring programs will ensure that the Pad A site continues to protect human health and the environment from any unacceptable risks.

For those remedial actions that allow hazardous substances to remain onsite, Section 121(c) of CERCLA requires that a review be conducted of the remedy within five years after initiation of remedial action and at least once every five years thereafter. The purpose of this review is to evaluate the remedy's performance - to ensure that the remedy has achieved, or will achieve, the remedial action objectives set forth in the ROD and that it continues to be protective of human health and the environment.

Monitoring data (groundwater, air, surface water, and soil) will be collected at Pad A and evaluated by the EPA and IDHW within two years of signing the ROD. This monitoring will be implemented to provide a baseline against which future site characterization can be compared, to provide early detection of a potential release to the subsurface, groundwater, or surface pathways, and to ensure continued effectiveness of the soil cover.

9.3 Estimated Costs for the Selected Remedy

A summary of the costs for each of the action alternatives was presented in Table 16. Table 17 provides a detailed breakdown of the estimated costs (i.e., $2.2 million) related to the Limited Action alternative. Costs for maintenance and monitoring of the Pad A site are the Net Present Value (NPV) dollars for 1992, using a 5% discount rate. These costs are calculated using NPV since they extend several years into the future.

10. STATUTORY DETERMINATIONS

Remedy selection is based on CERCLA, as amended by SARA, and the regulations contained in the NCP. All remedies must meet the threshold criteria established in the NCP: protection of human health and the environment and compliance with ARARs. CERCLA also requires that the remedy use permanent solutions and alternative treatment technologies to the maximum extent practical and that the implemented action must be cost-effective. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 Protection of Human Health and the Environment

As described in Section 9, the selected remedy satisfies the criterion of overall protection of human health and the environment by minimizing the risk of potential contaminant migration to groundwater and by preventing direct contact with the Pad A waste materials. The remedy will ensure that cumulative carcinogenic risk levels are maintained within the NCP risk range (1 additional cancer in 10,000 to 1 additional cancer in 1,000,000), and the cumulative hazard index is maintained less than 1.

The selected remedy will upgrade the existing cover to improve the cover slope and contours. The cover will be designed to incorporate erosion control measures to reduce the effects from rain and wind. The selected remedy ensures that the Pad A cover receives maintenance which includes subsidence correction and erosion control. Monitoring of Pad A will continue and will include sampling of water, air, and soils at Pad A to ensure the effectiveness of the existing cover and the protection of groundwater. The agencies will continue to review the action, within two years, and at least every five years thereafter, to ensure that human health and the environment are being protected. Additionally, institutional controls (i.e., access/land use restrictions, controlling public access, posting signs, and erecting/maintaining barriers), will be implemented to prevent direct exposure to wastes. No short term risks will be incurred as a result of this remedy.

10.2 Compliance with ARARs

The selected remedy of limited action will be designed to meet all ARARs of federal and state regulations. The ARARs that will be achieved by the selected alternative follow.

Table 17. Limited action detailed cost estimate.

Item	Qty.	Unit	Bare Costs Per Unit Mat'l	Labor (1)	Equip.	Sub-contract	Source (2)	Bare Costs Mat'l	Labor	Equip.	Sub-contract	Total Cost
REMEDIAL ACTION												
CONSTRUCTION												
Water Tank/Dust Cont.	320	hr		$26.04	$15.03		016 420 6900	$0	$8,333	$4,810	$0	$13,142
Limited action-grading												
Graded fill material	19000	cy				$2.15	(3)	$0	$0	$0	$40,850	$40,850
Vegetation/seeding	138	msf	$7.22	$6.60	$6.25		029 308 2300	$996	$911	$863	$0	$2,770
Diversion ditches	1520	lf				$2.00	(3)	$0	$0	$0	$3,040	$3,040
Fencing	1,800	lf				$25.00	INEL cost est.	$0	$0	$0	$45,000	$45,000
Signage	18	ea	$33.00	$14.65			104 304 1200	$594	$264	$0	$0	$858
Mobilization	5% of construction.							$80	$475	$284	$4,445	$5,283
SUBTOTAL CONSTRUCTION								$1,670	$9,983	$5,956	$93,335	$110,943
OPERATIONS												
Air Monitoring	1	ea				$70,000	Air Sciences	$0	$0	$0	$70,000	$70,000
H & S	4800	hr		$36.59			INEL cost est.	$0	$175,632	$0	$0	$175,632
SUBTOTAL OPERATIONS								$0	$175,632	$0	$70,000	$245,632
SUBTOTAL CONSTRUCTION & OPERATIONS								$1,670	$185,615	$5,956	$163,335	$356,575
Overhead & Profit	20% of remedial action							$334	$37,123	$1,191	$32,667	$71,315
G&A	5% of materials							$83				$83
Bond & Insurance	2% of remedial action							$33	$3,712	$119	$3,267	$7,131
SUBTOTAL REMEDIAL ACTION DIRECT COSTS								$2,121	$226,450	$7,266	$199,268	$435,105
POST-CLOSURE												
O&M												
Annual insp./env. monit.	30	yr				$45,000	(3)	$0	$0	$0	$691,760	$691,760
Land surface care	30	yr				$1,000	(3)	$0	$0	$0	$15,373	$15,373
SUBTOTAL POST-CLOSURE DIRECT COSTS								$0	$0	$0	$707,133	$707,133
SUBTOTAL DIRECTS								$2,121	$226,450	$7,266	$906,401	$1,142,238
INDIRECTS												
Construction Mgmt.	17.1% of remedial action						INEL cost est.	$363	$38,723	$1,242	$34,075	$74,403
ED&I	35% of remedial action						INEL cost est.	$742	$79,257	$2,543	$69,744	$152,287
Project Management	22.5% of direct costs						INEL cost est.	$477	$50,951	$1,635	$203,940	$257,003
Management Reserve	12.5% of remedial action & CM						INEL cost est.	$310	$33,147	$1,064	$29,168	$63,688
SUBTOTAL INDIRECTS								$1,892	$202,078	$6,484	$336,927	$547,381
SUBTOTAL DIRECTS & INDIRECTS								$4,013	$428,528	$13,750	$1,243,328	$1,689,619
Contingency	30%						INEL cost est.	$1,204	$128,558	$4,125	$372,998	$506,886
TOTAL ESTIMATED COST								$5,217	$557,087	$17,875	$1,616,326	$2,196,505

Notes:

(1)Asterisk indicates labor rate is increased by a factor of 2 due to hazardous level B work and heat stress.

(2) Numbers indicate unit prices used from 1991 Means Cost Data; Names indicate company who provided estimate.

(3)Research report on landfill costs by Creative Ventures, Ltd.

10.2.1 Chemical-specific ARARs

No chemical-specific ARARs are identified for the selected remedy.

10.2.2 Action-specific ARARs

Certain substantive IDAPA closure and post-closure requirements [IDAPA §16.01.05008 (40 CFR 264.310)] will be met for closure and post-closure care of Pad A. The relevant and appropriate requirements specify standards for final cover requirements, cover maintenance, and monitoring of Pad A following closure.

The relevant and appropriate substantive requirements of the rules for the Control of Fugitive Dust (IDAPA §16.01.01251 and IDAPA §16.01.01252), which specify that all reasonable precautions be taken to prevent the generation of fugitive dusts, must be complied with.

10.2.3 Location-specific ARARs

No location-specific ARARs are identified for the selected remedy.

10.2.4 To-Be-Considered Guidance

In implementing the selected remedy, the agencies have agreed to consider a number of procedures or guidances that are not legally binding. The following are to be considered guidance documents:

- DOE 5820.2A, "Radioactive Waste Management"
- DOE 5400.5, "Radiation Protection of the Public and the Environment"
- OSWER 9234.2-04FS, October 1989, "RCRA ARARs: Focus on Closure Requirements"
- OSWER 9476.00-1, September 1982, "Evaluating Cover Systems for Solid and Hazardous Waste" (Revised)

DOE Order 5820.2A addresses future control of the site and provides the requirement that DOE maintains active institutional control of low-level radioactive waste disposal sites for 100 years following closure (in this case, closure of the SDA). Institutional controls that would be implemented to continue control of the facility may include, but are not limited to, deed restrictions on future land use, controlling public access, posting signs, and erecting barriers or fences. DOE Order 5400.5 provides radiation protection standards for the general public from activities conducted at DOE sites. The OSWER directives provide additional guidance on the design specifications for constructing and maintaining a cover system.

10.3 Cost Effectiveness

Based on expected performance, the selected remedy has been determined to be cost-effective because it would provide overall effectiveness proportional to its costs when compared against the other alternatives.

10.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions to the maximum extent practicable for this site. The NCP prefers a permanent solution whenever possible. Because this site has a large volume of low concentrations of hazardous substances that can be reliably controlled in place, the alternative focuses on maintenance of the existing cover, monitoring, and institutional control of Pad A. The selected remedy provides protection by minimizing the risk of potential contaminant migration to groundwater and by maintaining the inaccessibility of the Pad A waste materials. Based on evaluation of the CERCLA remedial alternative criteria, and in particular the five balancing criteria, limited action will provide the best solution in terms of long- and short-term effectiveness, cost, and implementability.

10.5 Preference for Treatment as a Principal Element

Because the Pad A investigation and risk assessment indicated that the cover would reliably control Pad A wastes in place, this remedy did not consider treatment as a principal element of the remedy.

11. DOCUMENTATION OF SIGNIFICANT CHANGES

Following the Pad A public meetings, additional soil, and soil moisture monitoring data associated with Pad A became available to the agencies. This information has been evaluated by the agencies and has been determined to have no impact on the remedial alternatives discussed in the Pad A Proposed Plan nor on the remedy selected in the ROD. Because the data were not previously available for public review and comment, the results from the sampling activities are being provided in the interest of completeness of the RI/FS.

In May 1992, 38 soil samples were taken from various locations on the Pad A soil cover. Radionuclides detected in several of the samples included Am-241, detected in nine samples with concentrations ranging from 0.78 to 6.66 pCi/g, Cs-137 detected in five samples with concentrations ranging from 0.06 to 0.1 pCi/g, and Co-60 detected in only one sample at a concentration of 0.14 pCi/g. The measured concentrations are consistent with concentrations detected in past environmental monitoring/sampling activities conducted at Pad A and other areas of the RWMC and were determined to warrant no further consideration.

The Pad A overburden soil inorganic results were screened against INEL background surface soil concentrations established in 1989. Only three inorganic contaminants, beryllium, mercury and manganese, were present in some of the samples above the INEL background levels. Beryllium was detected in one sample at a concentration of 84.6 mg/kg above the background concentration of 2 mg/kg. Mercury was detected in two samples at a concentration of 0.11 mg/kg and 0.75 mg/kg above the background concentration of 0.06 mg/kg. Manganese was detected in five samples at concentrations from 629 to 869 mg/kg. The background concentration for manganese is 636 mg/kg. All other metals were not present above INEL background levels at the 95% confidence limit. Based on the limited number of sample results above the INEL background levels, the measured concentrations were determined to warrant no further consideration.

VOCs were detected positively in only two of the 38 samples. These two sample results indicate a potential single isolated VOC source within Pad A. The amount of VOCs posed by these isolated sample results is considered to be very small and, as such, would have no impact on the previous decisions. Additionally, the planned institutional controls to be implemented by this ROD will adequately prevent any exposure to the VOCs.

In addition to these soil samples, one set of soil moisture samples was obtained in June 1986 from two wells located at the south end of Pad A at a depth of 4.37 m (14 ft 4 in.) and 2.64 m (8 ft 8 in.). The soil moisture samples were analyzed for nitrates and showed concentrations of 13 and 48 mg/kg. As with the overburden sampling, the concentrations suggested by the samples are adequately bounded by the Pad A BRA and deemed to have no impact on previously reported results.

The cost estimates in the ROD reflect contingency costs associated with each alternative. These contingency costs were not discussed in the Proposed Plan and did not measurably affect the evaluation of alternatives.